EDITORIAL

PROMINENT in the news during the month has been the matter of reducing electrical interference with radio and TV reception. It is now penetrating through the minds of many in a position to do something about it that no longer can we avoid tackling the problem of cleaning up the ether.

The pity of it is that we left it so long.

At the moment the emphasis seems to be on car ignition, which causes probably the most widespread type of interference.

Fortunately it is one of the simplest to handle, at least to the point where its nuisance value is adequately reduced.

It is most virulent at the frequencies used here for TV, and appears to reach a peak round about Channels 1 and 2.

Overseas, the use of suppressors on vehicles is becoming standardized.

But there are many other sources of electrical interference which are long overdue for attention, and some of them are by no means easy to treat successfuly.

Many of us have suffered from corona effects at the insulators of high voltage power lines which run down some suburban streets. Even on the broadcast band, particularly in places where field strength is not good, the racket from these things spoils many a programme.

And then there are the countless x-ray and industrial moulding plants, which sweep their oscillator frequencies over communication bands to cause great annoyance and disruption of services.

The weakness in the position, as I have many times pointed out, is that there is no effective legislative power which can be called upon to compel offenders to take the necessary steps for cleaning up their installations.

The PMG through its various departments has been extremely helpful in tracking down suspected sources, and in making suggestions to all concerned about what they should do. But, while the Department does not for obvious reasons advertise the fact, it has no power to take any action against those who offend, unless, of course, the culprit is operating equipment covered with a PMG licence which can be suspended or withheld.

That is the key to the matter. It no use making a fuss about electrical noise unless, in the final analysis, someone can enforce the appropriate regulations.

If TV can bring about that state of affairs, we can bless it, if for no other reason.

John Moyle

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RADIO ★★ TELEVISION AND HOBBIES

A NATIONAL MAGAZINE OF RADIO, TELEVISION, HOBBIES AND POPULAR SCIENCE

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OUR COVER PICTURE

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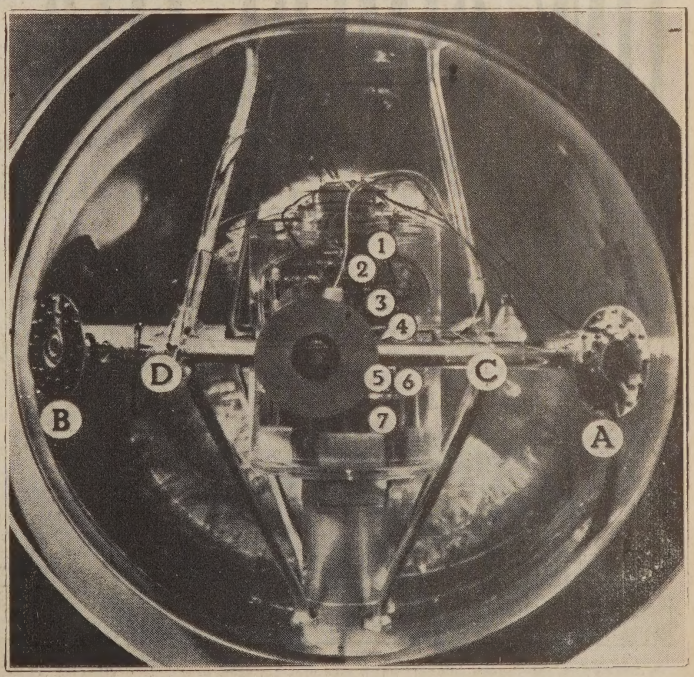
A SATELLITE FOR OUTER SPACE

TWO pictures of the outer space satellite recently exhibited by the US Navy. Dr. A. V. Astin, Director of National Bureau of Standards (above), indicates the aerial rods which will be used to transmit back secrets from outer space.

The satellite, shown at the right in cut-away form with plastic cover over its working parts, is 20 inches in diameter and weighs, fully loaded, about 21 pounds. Here is the key to letters and numbers as put on the various parts by the Navy: (A) Cell, operating on energy from sun, to reset recording device on each orbit around the earth; (b) Ultra-violet detector; (C) Oxides to measure objects; (1) Transmitter for relaying data to earth; (2) Amplifier to detect collision with micrometeorites; (3) Storage unit to record data from amplifier; (4) Device for transmitting scientific data to a ground station; (5) Memory unit, to give data stored up during an orbit as satellite passes over recording stations; (6) Current amplifier to measure ionisation from ultra-violet radiation: and (7) Mercury batteries for power supply.



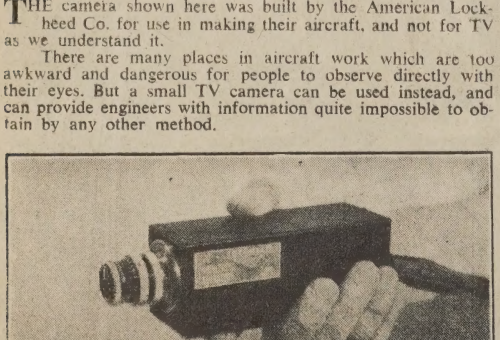
The new midget camera was used to cover the Presidential elections in USA. Shown here for comparison are (Top Centre) Standard TV camera on dolly, (Centre) New Dage camera, small enough to be lifted and moved quickly by one man (Left) New completely portable INTEC camera, weighing less than four pounds with lens and view finder — actually a mobile TV station. Power supply, generator and transmitter, weighing 32lb are carried on operator's back and (Right) the new camera.

TINY CAMERA FITS THE HAND

In the move to miniaturise electronic equipment, apparently nothing is immune. Designers are now turning their attention to TV cameras, which by today's standards are large and unwieldy. This article tells of a new and tiny camera built round the world's smallest tube.

THE camera shown here was built by the American Lockheed Co. for use in making their aircraft, and not for TV as we understand it.

There are many places in aircraft work which are too awkward and dangerous for people to observe directly with their eyes. But a small TV camera can be used instead, and can provide engineers with information quite impossible to obtain by any other method.



A close-up of the rugged midget, which measures 5in long by 2in square. It weighs only 24oz and uses a German camera tube.

Although the camera was intended primarily for such work, it is possible to use it for broadcast type TV, and it has already been of great value in the USA in connection with the Presidential elections.

It has scanned the packed lobbies and peered into crowded rooms where a full-sized camera could not go.

It is of particular value, therefore, to newsmen, who can manage it with one hand, and aim it very much as a miniature camera fan does when framing his 35 mm shots.

The camera is expected to show the way to new techniques in shooting programmes.

The camera tube is made in Germany, and is not very much larger than an ordinary cigarette, being about twice as long and of larger diameter.

The standard camera tube uses a 35 mm lens and is therefore classed as a 35 mm tube. For some time now, a smaller 16 mm tube vidicon has been used, generally in industrial cameras, which allowed a very much smaller unit to be built around it.

The new micro-miniature on the same basis is only 8 mm in diameter and can be fitted into an envelope only five inches long and two inches square. In America it costs about £300.

One of the most interesting technical developments associated with the tube concern the methods to reduce the effects of shock, and to obtain remote focusing, both of which are covered by Lockheed patents.

Charles Aker, designer of the camera, tells of some uses for it devised by his aircraft manufacturing firm.

"TV's uses multiply like rabbits," Aker said. "Once our manufacturing departments found out that TV was becoming available, they've devised nearly a new use per week.

"One place we plan an early installation is on a Drivmatic automatic riveting machine. The operator must check both sides of a panel to make sure the rivet is properly driven. This means bending over and looking underneath.

CHECKING RIVETS

"A TV camera trained on the underside of the panel with a monitor in view of the operator would solve the problem — and far better than an optical set-up."

But the main use of TV is still in engineering research and flight test.

Currently the hottest use of the TV system is for inspection of the plenum chamber of the F-104.

The air ducts for the F-104 jet fighter curve back into a central collecting section called a "plenum chamber". The ducts are too small for a man to crawl in and the curve is too great, even with a mirror and flashlight on a pole, for an inspector to take a good look at the chamber — a likely repository for miscellaneous nuts, bolts, rocks, and other small objects sucked up by the engine, or birds or animals that might slip in while the duct covers are off.

A REMOTE EYE

The power plant lab men mount the TV camera on a little dolly with a floodlight and wheel it in the duct. By watching the monitor screen outside and manoeuvring the dolly, the inspector can make a thorough check of the chamber and insure no loose objects are present that might damage the engine when it is fired up.

TV also casts an electronic glance at other items of interest at Lockheed where it is impossible or inadvisable for a human eye to be. Recently the research icing tunnel has been doing icing checks on the carburettor inlet screen of the Super Constellation, attempting to devise improved alcohol de-icing techniques.

A Lockheed TV camera, mounted in a special streamlined mount in the wind-tunnel, stares straight down the throat of the carburettor while Charles Fish, group engineer on the icing project, observes the ice formation on a monitor screen outside and records data.

Fitted with a pistol-grip handle, this is how the camera is used for ordinary TV work. It is proving of great value in TV news series and may eventually be used in Australia.

STRUCTURAL TESTS

A Lockheed TV camera, watches rivets pop and cracks form on a panel from a section out of a 1649 Constellation fuselage while engineers behind a protective barrier apply increasing load through hydraulic jacks to see at what point the structure will fail.

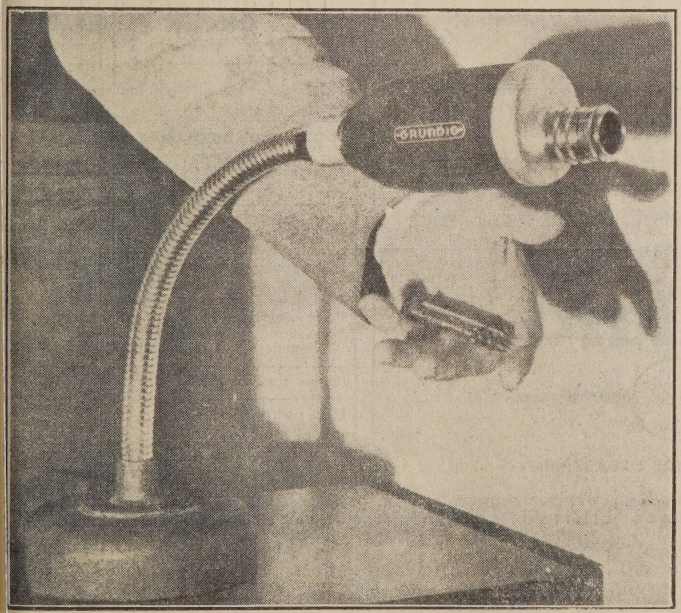
With a TV camera mounted on the tail of a C-130, the late Stan Beltz and Maj. Gen. Boyd could watch the air flow tufts on the horizontal stabiliser waver in the air as the plane approached a stall. They could gauge the exact instant of stall by movement of the tufts.

Most people when they think of television in flight test picture a camera leaning over a pilot's shoulder watching the instruments. While this is possible, it's not necessary — this data can be telemetered back more economically.

TESTS IN FLIGHT

The best use for a TV camera in flight test is to put it somewhere, aimed in a direction that the pilot **can't** see — say on the underside of the wing at the tip where it can view the far side of the outboard engine, or on a fighter behind the pilot's head looking back at the tail assembly. This is where the TV camera pays off.

Flight test engineers have used the TV camera to watch landing gear retraction, observe airloads on landing gear doors in various flight attitudes, and in general to serve as a prying eye where the human eye just can't go.



Ths camera, produced by Grundig of Germany, uses the same tube as in the Lockheed camera.

Transistor News from Mullard

PHOTOTRANSISTORS

NOW AVAILABLE TO INDUSTRY

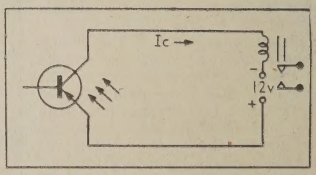
The first phototransistors to be made generally available are announced by Mullard. These phototransistors, type OCP71, are of germanium p-n-p construction and have a spectral response which covers the visible range and reaches a maximum in the infra-red region.

They are small and robust and may be employed in a variety of industrial applications in circuits of unusual simplicity. Normal relays may be operated direct from the OCP71, making intermediate amplification unnecessary.

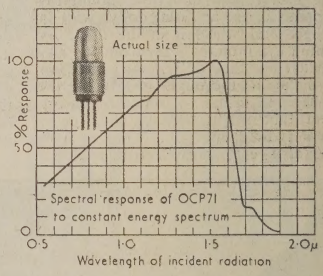
The sensitive area is large compared with a photodiode and no complex or critically adjusted optical accessories are required. With an effective sensitive area of 7 sq. mm. the sensitivity in conventional terms is 0·3A/lumen.

Signal-to-noise ratio is good for such a sensitive device, and the cut-off frequency when used with a modulated light source is about 3 kc/s.

Further information on the OCP71 phototransistor and other transistors is readily available from the address below.



Basic relay circuit employing the OCP71 in which the base is left unconnected. In practice a small positive base voltage decreases the dark current and in modulated light applications the base circuit may be tuned to increase the signal-to-noise ratio.



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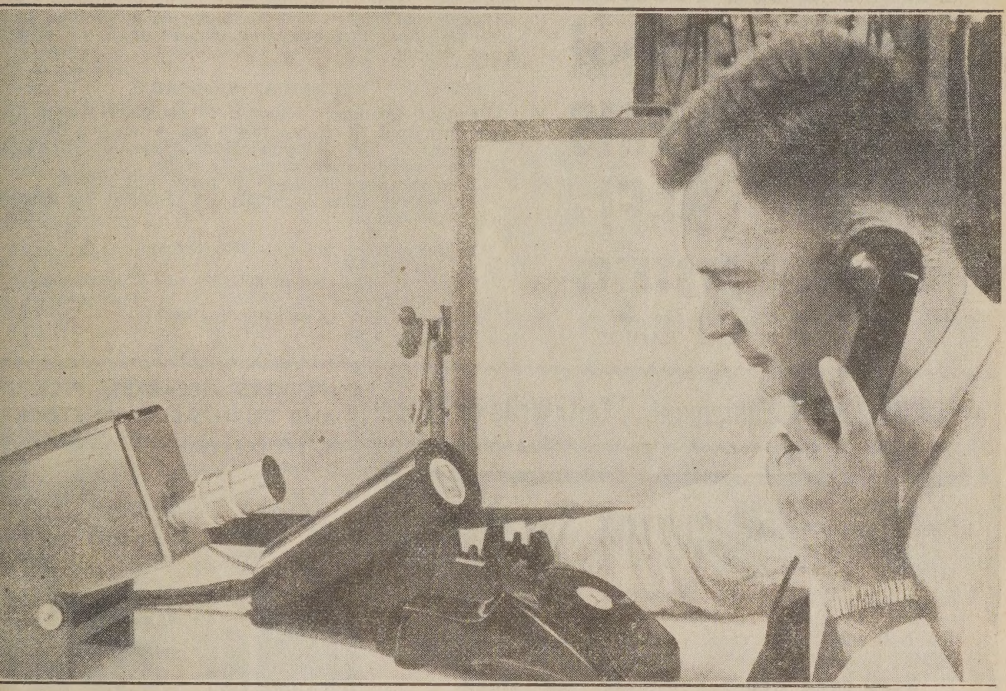
TV TELEPHONE COMES NEARER



Lloyd Becker, of Bell Telephones, demonstrates the new Picture-phone. Still in its developmental stage, the system would require only one additional telephone line on a customer's premises.

A telephone that transmits pictures along with sound has taken a big step toward commercial feasibility, according to information released by the Bell Telephone Laboratories whose engineers have used an experimental "Picture-phone" system to transmit recognisable pictures over short and long distances, even as far as from New York to Los Angeles.

XPERIMENTAL pictures vary in size from one by one and a half nes to two by three inches, and are wed from one to two feet away. Un- television, a new picture is displayed ry two seconds. It has good black- -white contrast and the person at the er end of the line is recognisable. ad and shoulders can be seen and al expressions are readily apparent. he Picture-phone is the first system its kind to use a pair of ordinary tele- ne wires. This is what gives it pro- e of being commercially feasible. y one other line, consisting of a pair wires like the regular telephone line, ld be installed on the customer's pre- es to carry the picture.

t will be possible for a caller's pic- e to be "dialled" like an ordinary phone call, provided the switch on picture equipment is turned on at h ends of the line. If the switches off, the telephone call will be com- ed without pictures. The picture also be turned on after a conversa- is under way. It would be impos- e for a customer to be seen by the caller unless he flipped on the switch.

Operation of the system has been made possible by slowing down the rate of transmission of picture information to such an extent that the required bandwidth can easily be handled by conventional telephone circuits.

The raster is made up of 60 lines, each of which may have a maximum of 40 dots. Thus each complete frame may be thought of as being made up of 2400 dots. If a single frame were transmitted each second, an overall bandwidth of 1200 cycles per second would be necessary. With the present system, one complete picture is transmitted every two seconds, requiring a bandwidth of 600 cycles per second.

CARRIER SYSTEM

This 600-cycle "video" band contains very low frequency components which might suffer undue attenuation during transmission over phone lines. Therefore, a carrier scheme is employed in which the "video" signal amplitude-modulates a 1200-cycle carrier.

The transmitted intelligence is then a conventional amplitude - modulated double-sideband signal with a frequency range of 600 to 1800 cps. This signal lies within the range of optimum transmission of telephone lines, and so can be treated exactly like a voice signal. It can be passed through repeaters, and transmitted via microwaves, coaxial cable, twisted pair, or open wire lines.

An analysis of the overall system can best be made by referring to the block diagram. This diagram outlines one possible line-up of components which has been tested experimentally.

A conventional TV camera of the type employed in industrial TV systems is indicated. This camera contains a Vidicon tube and the necessary horizontal and vertical sweep circuits for producing a raster. These circuits are so adjusted that the 60-line raster mentioned above is obtained, with one complete scan occurring every 1-20th second.

Since the transmitted picture repetition rate is only one every two seconds, a total of 40 scans is available in the two-second interval. One of these scans is abritrarily selected and the remaining 39 are unused. The information in this scan is recorded on a magnetic drum

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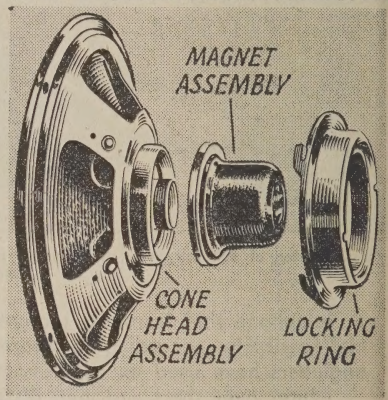

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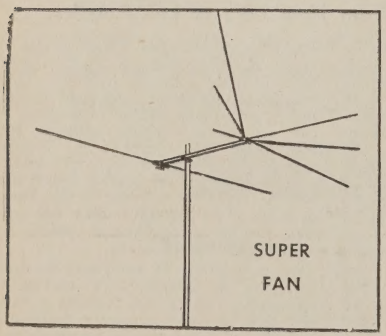

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which is rotating at a speed of 20 revolutions per second. All of the picture information for a single frame is thus recorded on a single rotation of the drum.

By means of suitable gating and timing circuits this stored information is then picked off the drum at 1-40th the rate at which it was recorded. Thus, by the time it has turned 40 revolutions (an interval of two seconds) all the information from a single scan has been passed on to the modulator and the drum is erased and made ready for the next picture.

At this point, timing and synchronising data are combined with the signal to be transmitted. Such data are added in much the same manner as synchronising information is combined with a conventional TV signal.

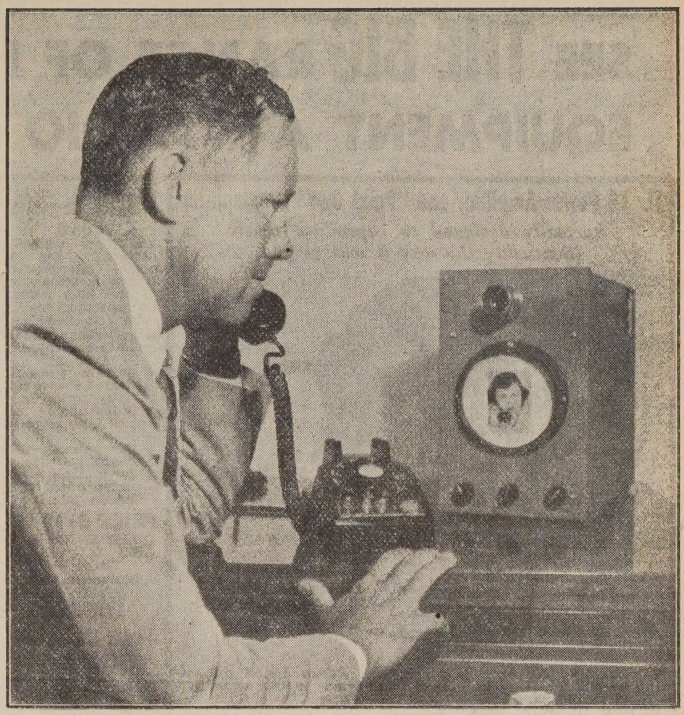
STORAGE PROPERTIES

It is possible to take advantage of the storage properties of the camera tube itself and thus eliminate the magnetic drum memory system. By means of a suitable shutter arrangement the image tube can be made to receive a momentary image once every two seconds and then the whole two seconds used for the scanning procedure. The signal thus derived can be sent directly to the modulator. Sufficient experience has been gained with this technique to indicate that it is feasible.

Conventional modulating and demodulating techniques of the type used in telephoto equipment are employed in the system. At the receiver the synchronising information is removed from the signal and used to control suitable horizontal and vertical sweep circuits. The remaining picture information is then presented to a suitable display medium which, in the case of the block diagram, is a pair of Iatron direct-view storage tubes.

The Iatron at present being used is a recently-developed commercially available electrostatic storage type of tube which uses electrostatic deflection. It has an inner screen just behind the fluorescent coating on which a picture may be stored by means of an electron gun and suitable scanning circuits. During this storing process the face of the tube remains dark. Once the picture is stored it may be made visible by means of a flood of electrons provided by a second electron gun. The picture will last for several minutes, if desired, and may be erased at will by applying a suitable potential to one of the electrodes.

As can be seen from the block diagram, the present equipment employs two Iatrons, placed at right angles to each other, with a half-silvered mirror located as shown. Thus, the viewer can see the image on either of the tubes when the other one is dark. The technique is to write the information on one tube while the other is being viewed, and then to switch over so that a new picture is written on to the second tube while the first is being viewed. Since each picture appears for two seconds, the viewer sees a picture change every two seconds.



How the Picture-phone works out. The camera lens can be seen protruding above the picture of 2 x 3 inches. Final models will probably be smaller and more convenient.

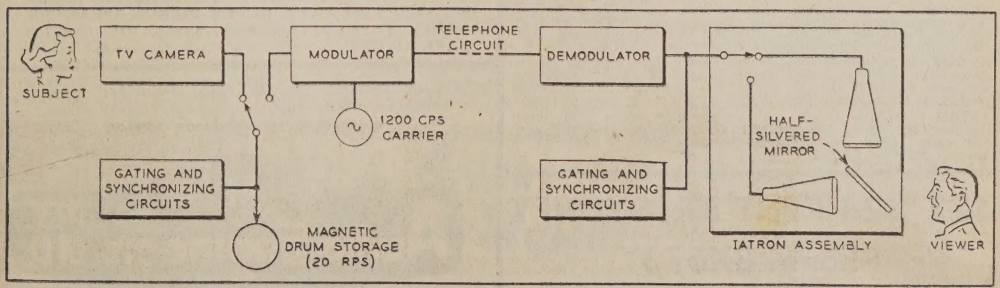
MAGNETIC DRUM

An alternative receiving arrangement which has been successfully tested at Bell Laboratories is a combination of a magnetic drum storage system and an ordinary cathode-ray tube of small size. The drum memory system stores the incoming picture information, and then feeds it to the cathode-ray tube. Two magnetic drums are necessary, so that one is storing information from the telephone line while the other is feeding information from the previous scan to the picture tube. This arrangement is essentially the reverse of the magnetic storage system employed in one version of the transmitter.

Still another receiving system which is being investigated at Bell Laboratories is the use of a facsimile-type of recorder which prints the pictures on a small strip of paper, one every two seconds. Brightness is then limited only by the illumination on the picture once it appears on the strip, and a prism arrangement can be employed for viewing purposes, so that to the viewer the image remains stationary for the full two seconds, even though the strip of paper is moving. This system has the added advantage that the pictures are available as a permanent record for future reference.

In its present form, equipment for the Picture-phone is rather bulky and expensive. However, a number of avenues are being explored for reducing

(Continued on page 73)



A block diagram of the Picture-phone system.

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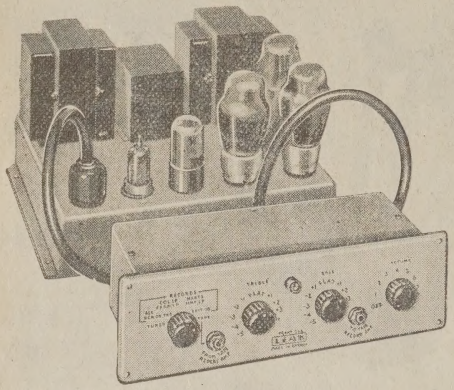
TL/10 Power Amplifier and "Point One" Preamplifier

Specially designed to reproduce music identically the way it was played.



CIRCUITRY: A triple loop feedback circuit based on the famous TL/12. The output transformer is the same size as in the TL/12.
POWER OUTPUT: 10 watts.
FREQUENCY RESPONSE: + or — 1 db, 30 c/s to 20 kc/s.
LOUDSPEAKER IMPEDANCES: Three tappings are available and loudspeakers of any impedance between 3 ohms and 20 ohms may be used.
TREBLE CONTROL: Continuously variable control of treble from + 9 db to —15 db at 10 kc/s.
BASS CONTROL: Continuously variable control of bass from + 12 db to —13 db at 40 c/s.

TL/10 COMPLETE **£76/13/-**

Full range of Loudspeaker Dividing Units available

2-way 1000 cps ½ section unit	£9/16/10
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IDEAL BASS SPEAKER "THE 15" C.S. 15 WATT BAKER

The 15/C.S. AUDITORIUMS have an extremely level response up to well above 5000 c/s and are the best BASS REPRODUCERS available for use with multi-speaker installations of high fidelity.

VOICE COIL IMPEDANCE .. .. 15 ohms
VOICE COIL DIAMETER 2in
CONE RESONANCE .. .. .. 25/30 c/s.
FLUX DENSITY .. .. 15,000 lines per sq cm

PRICE **£39/3/11**

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AUDIOM 60 12in. Available with a bass resonance of 35 cps. It is particularly suited for use as a bass speaker in High Fidelity Crossover Systems with the Axiette or other suitable treble units. Flux Density—14,000 gauss. **PRICE £22/18**

AXIOM 150 MARK II 12in. A full range High Fidelity reproducer with a power handling capacity of 15 watts. Frequency response 30/15,000 cps. Fundamental resonance 35 cps. Flux density 14,000 gauss. **PRICE £26/8/3**

AXIOM 22 MARK II 12in. A twin-cone 20 watts P.M. loudspeaker, combining generous power handling capacity with full range High Fidelity reproduction. Flux Density—17,500 gauss. **PRICE £40/2/-**

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- **Independent filter and filter slope controls.**
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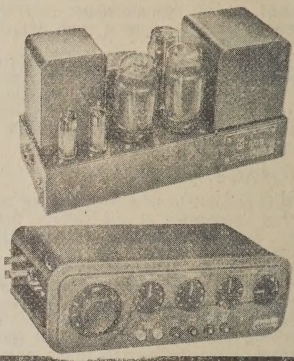
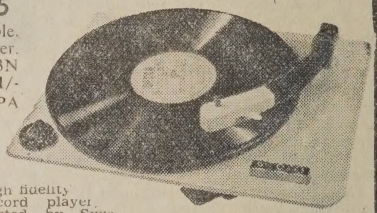


PRICE £113/12/6
QUAD II AMPLIFIER AND Q.C. II CONTROL UNIT

THORENS CBA83N RECORD PLAYER

Model CBA83N
£50/15/5

Now available, record changer model CD43N at .. **£69/11/-**
Model E53NPA Turntable and Motor Unit at **£35/1/10**



A precision high fidelity automatic record player, built and tested by Swiss craftsmen. Famous E53N direct-drive, governor-controlled motor, with continuous speed adjustment at each of three speed positions (33-1/3, 45 and 78 rpm)—muting switch tone arm tracking force adjustment screw. Balanced, heavy 12in. turntable. Unit complete with General Electric Variable Reluctance Pickup Cartridge with 2 sapphire styli. Diamond styli available for 6E pick-ups.

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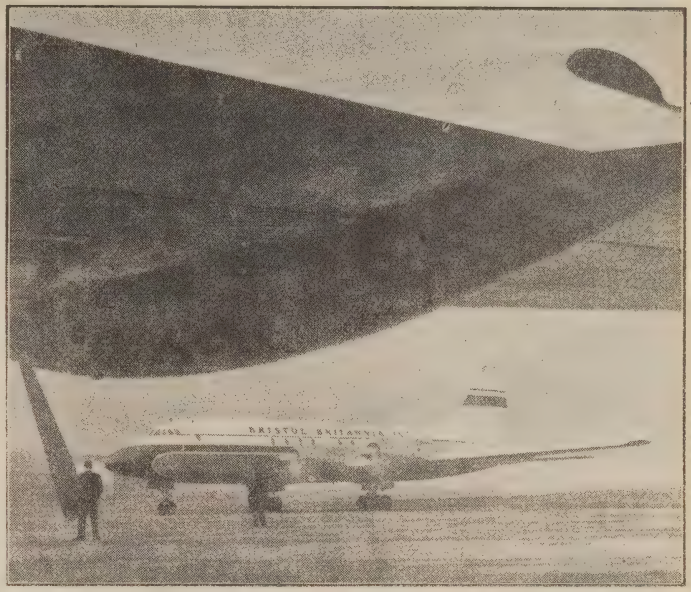
FARNBOROUGH SHOWS THE WAY

THIS year's emphasis is on engines. The show suggests that Britain will, in the next five years, make an indisputable claim to be the master aero-engine builder. And the returns are staggering. Few people appreciate that the power-plant for, say the transport version of the Boeing 707, will cost far more than a World War II heavy bomber.

Farnborough showed that engine development in the past two years has been really extraordinary. At the head of a long list of new arrivals I place the Bristol "Orion". This engine's wonderful quality is its ability to compensate automatically for increases in altitude.

As a trim turbo-prop it is meant to work at 5150 horsepower. A major design feature has been power-limitation and its supercharge qualities permit full rated take-off power to be obtained at 15,000 feet. Maximum rating does not fall before 25,000 feet. BOAC has purchased 60 complete "Orion" installations for their long-range Britannia 312s. Folland, who make the "Gnat", and firms in Italy, France, Yugoslavia, Spain and Japan are interested.

A match for the "Orion", but in quite a different and perhaps more restricted field, is the mighty de Havilland "Gyron".



G-ALBO, the first Britannia prototype, is now being used for engine development flying, and appeared at Farnborough with three different engines—one Bristol Brion supercharged turboprop, one Bristol Proteus 755 turboprop, and two Bristol Proteus 705 turboprops.

The Society of British Aircraft Constructors' annual display at the Royal Aircraft Establishment at Farnborough re-asserted itself this year as a buyers' show. It was less of an "air circus" and more of a sober reflection of significant trends.

TOP PRIORITY "GYRON"

Development work on the "Gyron" has been a top priority with de Havilland for the past 12 months, a sure sign of remarkable performance. Officially rated at 15,000 pounds thrust, the engine can achieve 20,000 with ease. In fact, a well-informed source told me after watching the fighter-like antics of the Gyron test-bed, and the Short "Sperrin "They don't really know the maximum punch of this engine. It can probably make 30,000 pounds."

This is a fantastic figure, remembering that the thrust of all four engines in the Vickers "Valiant" V-bomber totals 40,000 pounds and even the "Vulcan's" four-engine thrust does not exceed 50,000.

Another giant, the Rolls-Royce "Conway" by-pass turbo-jet, has rich new orders in the book. This "prestige" engine, with an announced thrust of 13,000 pounds, is to be the powerplant for the Boeing 707 now on order for TAA and for Douglas 8s of Trans-Canada Airlines. The "Conway" is said to be lighter and cheaper than any known American engine of equal rating and is the only known engine to use the by-pass principle. In this the excess air produced by the compressor is passed around the engine to emerge as a working jet.

The Bristol "Olympus" is in the forefront of engines now hard at work in regular service. This engine has the finest thrust-weight ratio of any known turbo-jet. It can achieve at least 12,000 pounds thrust—and must do so regularly in the English electric "Olympus Canberra", which holds the aircraft altitude record of more than 12½ miles.

AVON TURBOJETS

The largest single family of turbojets in existence, the Avons, have been further developed by Rolls-Royce in the last year. Avons of one type or another now power the DH 110 Mark 20, the Canberras (except the Olympus Canberra, of course), the Fairey Delta 2, the Hunters F4 and F6 and the Hunter trainer, the Valiant B1, the Swift FR5 and Mark 7 and the new Supermarine N113. The latest Comets have Avon RA29s, which give them a total thrust of 42,000 pounds. The two latest Avons, the RB106 and RB108, are still on the secret list. The RB106 is a high-thrust turbo-jet.

Probably the most startling innovations at Farnborough, giving us the first look we have had at power-packs for space travel, were the rockets and the ramjets. Security's guarded release of details on these motors gave interesting background on principles.

HOT AND FAST

The liquid rocket is an engine independent of atmosphere carrying its own fuel—liquid oxygen—which is released by combustion as a hot, fast jet at temperatures of 3000 degrees Centigrade. The jet can reach 7000 feet a second. The rocket can give 20 times its own weight in thrust, but as it carries its fuel supplies its propellent weight is about 15 times the fuel weight of an equivalent turbojet. The rocket is favored when the atmosphere is thin or non-existent and for short bursts of power.

At Farnborough the Armstrong Siddeley Screamer, the Napier Scorpion and the de Havilland Super Sprite were the chief representatives of the aeroplane rockets.

The Screamer has a thrust controllable between 1000 pounds thrust and 9500 pounds thrust. It weighs one-sixth of the equivalent-performance turbojet but uses 60 tons of propellent in an hour, compared with about four tons of kerosene fuel.

The Napier Scorpion was used in its Canberra test-bed with impressive results. Though its use in the Canberra

by Brian McGill

NEW

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Monarch UA8

Four Speed Autochanger

16 2/3, 33 1/3, 45, 78 r.p.m.

You need the 4-speed motor if your radiogram is to be really modern! And this mighty Monarch UA.8 brings important new features as well . . .

- ★ PROVISION FOR EASY MANUAL PLAY
- ★ A NEUTRAL POSITION DISENGAGES THE DRIVE — prevents flat spots developing on drive tyre
- ★ ADJUSTABLE STYLUS PRESSURE
- ★ NEGLIGIBLE WOW and RUMBLE

A logical development of the now well-known Monarch UA.6 Automatic Record Changer, the UA.8 is designed to play the new 16 2/3 r.p.m. "talking books" in addition to 33 1/3, 45 and 78 r.p.m. records.
Listening tests, reliability tests and laboratory measurements prove the UA.8 the finest Monarch yet. Transcription quality is now made available to every record user.

AVAILABLE FROM LEADING WHOLESALERS AND RETAILERS

Brief Technical Specification

1. **Record Capacity.**
The changer is designed to play ten 10in or 12in, or twelve 7in records. If in mixed sizes, the quantity should not be greater than ten.
2. **Speed.**
The changer operates at four speeds 16 2/3, 33 1/3, 45 and 78 r.p.m. The speed selector control is exact, reliable and includes a neutral position which disengages the jockey pulley tyre from the motor pulley. This facility ensures that the pulley does not develop "flats" during prolonged disuse.
3. **On/Off Control.**
The on/off control also has the facility to reject records at will. A manual position on this control enables the changer to be used as a single player, if desired.
4. **Automatic Shut-Off.**
When the record retaining arm is over the spindle the pick-up will return to the rest position and the motor will switch off after the last record has been played or rejected.
5. **Pick-up Arm.**
The diecast aluminium pick-up arm is rigid and resonance-free.
6. **Stylus Pressure.**
Adjustable to suit specific cartridges.
7. **Turntable.**
The 9in heavy steel turntable rotates on a ball bearing race, ensuring smooth operation. An air-cushioned mat protects the records.
8. **Motor.**
The motor is of the four-pole type, and is dynamically balanced.
9. **Rumble.**
Special attention has been given to designing this unit for low rumble.

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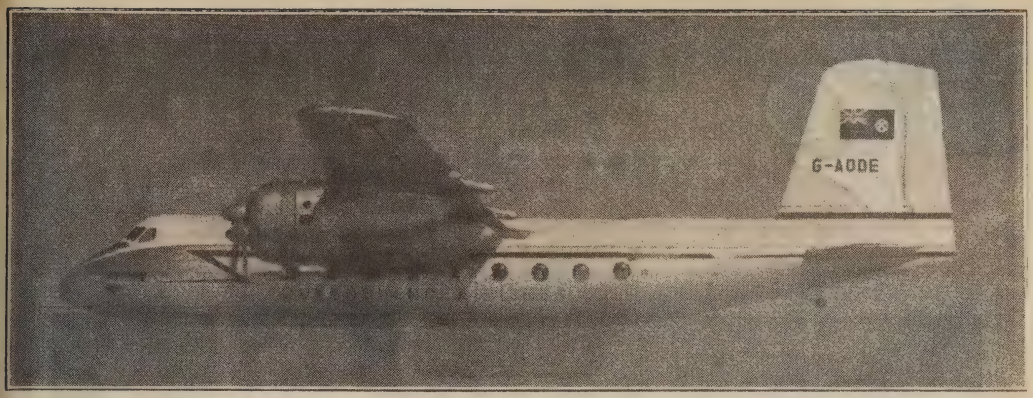

The Handley Page Herald Branchliner—a most attractive "workhorse."

did not show it the Scorpion will be most useful at high altitudes and for boosting heavy fighters in combat.

The Super Sprite produced fiery ear-shattering results in the Vickers Valiant. It is a temporary thrust booster, the rocket-and-propellent pack being jettisoned after take-off firing. It runs for 40 seconds with a peak thrust of 4200 pounds.

Ramjets are still highly experimental. Basically engines operating on the simplest level, they are narrow-bore pipes which collect air and expend it after high-temperature combustion. The ramjet is most efficient between Mach 3 and Mach 4—somewhere about 2500 miles an hour. Its compression of air does not reach a practical value until Mach 2.

This year's Farnborough sees the debut of the Bristol Thor, a six-foot-long stainless steel cylinder 15 inches in diameter in which air is initially compressed by a spike in the intake. This unit is intended for mounting as a pod on the body of a missile and an engine of this size flying at sea-level at Mach 3 could produce the equivalent of 90,000 horsepower.

Without wishing to suggest trends too forcefully I will place guided missiles ahead of aircraft. We had our first respectful look at the robots.

FIREFLASH MISSILE

The Fairey Fireflash appeared under the wings of a Swift and a Hunter F4. The bright red missile looked ungainly and precarious, though the Hunter particularly moved freely enough with its extra burden.

I gained the impression that there is nothing very complex about the Fireflash. It is powered by two large boosters which drop off after a few seconds. It carries an apparently efficient electronic homing device which engages the enemy at distances exceeding seven miles.

Air-Marshal Sir Thomas Pike, Air Officer Commander-in-Chief of Fighter Command, says that the Fireflash will be tested extensively in the Swift in December, but adds, surprisingly, "We do not intend to put it into service. There is one following it which is a lot better."

This new weapon could come from any one of a dozen firms heavily committed on the missile program. These include English Electric, Napier, Vickers and Armstrong-Whitworth. Of these, English Electric is most likely to enter the province of the Americans — the world of the intercontinental ballistic missile. We could look to the Thor or the Napier ramjet for a power-pack.

NEW SUPERMARINE

The only really new aircraft at the air display was the Supermarine N113, which flew briefly over the airstrip but did not land. Very little is known about the new plane, which is superficially not unlike the Swift. The plane is a Fleet Air Arm buy and can carry an A-bomb or guided weapon—not just missiles—at speeds substantially above the speed of sound. The Air Arm boasts that the N113 can match any RAF rival. Powered by twin Avons, it is certainly the most advanced deck-operating fighter known. It made its first deck landings six months ago and it is on order in large numbers. Design features include a saw-tooth swept leading edge and an all-movable tail section. A revolutionary "super-circulation" system blows air from the Avon compressors over the upper surfaces of the flaps to increase lift by local acceleration of the air flow.

Farnborough had no other military surprises. The glamor plane from last year's show, the Fairey Delta 2 research aircraft, was again the public's darling with a 1132-mile-an-hour world speed record painted on its fuselage. Surely the most ungainly of all high-performance aircraft on the ground, this delta-dart is a formidable piece of aero design. Two examples are now flying, both powered by a single Rolls-Royce Avon turbojet with reheat. Basic research on this aircraft is believed to be the greatest ever put into any British single-engined plane. The unique design features include a paper-thin wing and a dipping hydraulically-hinged fuselage which permits the pilot to see where he is landing.

The by now well-established V-bombers, the RAF's backbone, were elegantly flown. RAF pilots gave a masterly and striking display of slow flying in the lovely Vulcan. The great ray shape hissed gently over the airstrip at under 250 miles an hour.

Various marks of the Hawker Hunter flew. The Hunter flying display by an RAF acrobatic team was equalled only

The Bristol Thor Ramjet in its special test cell. Large quantities of air delivered at high velocity to the intake of the ramjet are necessary for static testing.

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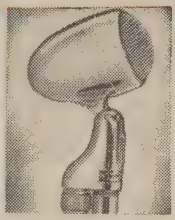
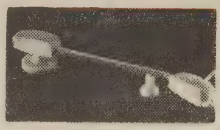
A.W.A. Ronette Crystal Microphones and Accessories

AWA RONETTE

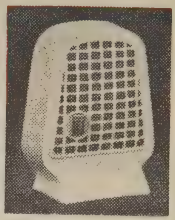
088/F. Filtercell, omnidirectional, with flexible chromium plated suspension.



GS210 and GS210/L. Streamlined, chrome finish, filtercell, high or low impedance.



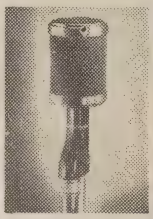
FF2-OV, FF2-P. "Fonofluid" turnover crystal pickup with alternate response characteristics.



44. Hand or desk mounting, counter balanced base, ivory plastic housing.

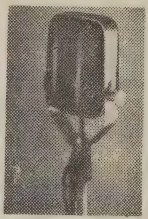
K407. Contact microphone for attachment to musical instruments — also used as throat microphone.

HM7. Hand or stand microphone, filtercell, robust diecast housing attractively finished.

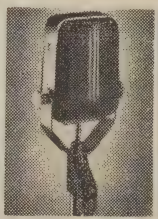


S742. Duo cell, omnidirectional, suitable for cable suspension.

B110. Plastic torpedo form.



R474. Studio type, 4 cell, omnidirectional.



R572 and R572/L. Studio type, duo cell, omnidirectional, high or low impedance.

RFC and RFCS/L. Single cell semi-directional, high or low impedance.

C53. Hand or stand, omnidirectional, black plastic housing and hand grip.

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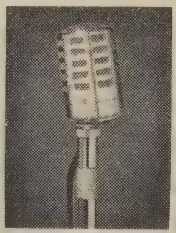

URA/S and URH/S. Ribbon velocity with sliding type muting switch. High or low impedance.

PGD and PGD/H. Dynamic with metal diaphragm. High or low impedance.

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by the fine touch-and-go fast runs of the Gloster Javelins.

The fine little Folland Gnat gave its usual display of manoeuvrability. The Gnat has landed its first big contract since Farnborough—a £3-million sterling order for India. The tiny supersonic jet, one-third the dimensions and weight and one-fifth the cost of today's big fighters, has much to recommend it to countries with limited defence budgets.

The show suggested that trainers are on the way up. The Hunting Jet Provost is still awaiting a Ministry of Supply order to produce in quantity. This 350-mile-an-hour jet is already giving National Servicemen their solos without piston experience. Hawker have produced a two-seater Hunter and Folland showed a two-seater Gnat. (I asked for a ride, but was told that the mock-up of the Gnat for the Farnborough display will not become a reality for a year.)

BRISTOL BEVERLEY

The Bristol Beverley, which first flew in 1951 and which has been a regular visitor to Farnborough over the years, gave an impressive and significant display of embarkation of 100 fully-equipped troops. The giant hold of the Beverley swallowed the National Servicemen in under two minutes. It then took off in about 600 yards (average 810) and landed in 400 yards. This aircraft's hold is as big as a small flat—40 feet long, 10 feet wide an 10 feet high.

On the civil front, I have already said the emphasis is on "under the bonnet". Since Farnborough, the Britannia's proving flights have been called off indefinitely, pending investigation of de-icing problems. This is a great pity. Every expert I spoke to at Farnborough had nothing but praise for the lovely Britannia 301 making its debut. This aircraft is the prototype of the Series 300 and 310 Britannias and was, until last week, being used for certification tests.

BRITANNIAS

The series 300 Britannias have a fuselage 10 feet longer than the Britannia 100. They will be delivered to airlines early next year for trans-Atlantic operation—if the de-icing trouble is not too serious. The Series 310 will carry its full payload of more than 15 tons or 93 passengers on regular non-stop services across the Atlantic. It has been ordered by BOAC (11), Canadian Pacific Airlines and El Israel Airlines (at least five each).

There are no clouds on the Vickers Viscount's horizon. This veteran continues to sail throughout the world. The Mark 802 was at Farnborough. From this, a family of more powerful, heavier Viscounts in the V.810 series, will develop. More than a hundred V.800s are on order from 13 airlines. The V.802 can carry 12,700 pounds over 620 miles, cruising at 320 miles an hour. The V.840, on order by Continental Air Lines of Colorado, can cruise at 400 miles-an-hour.

COMET DID NOT FLY

Only one Comet was on show at Farnborough. It did not fly. It was a C.2 long-range military transport, several of which have flown troops to the Mediterranean in recent weeks. Ten Comet 2's are on order for RAF Transport Command. Some may eventually enter courier service to Woomera. Cruising speed is 480 miles-an-hour.

The chief representative of an immensely important class was the Handley Page Herald. This is often described as the nearest replacement for the Douglas DC-3. It is certainly a most attractive "work-horse".

Its literally down-to-earth design was most impressive. It is as low-slung as most big fighters—lower than many. In the last year of testing the Herald had many tropical trials. Handley-Page obviously have their eye on the Commonwealth.

Not an inch is wasted in the interior. I was surprised to learn that it could seat 44 passengers. One point which is worth noting and which tempers my praise of the Herald as a Dakota replacement, is that it has four engines (850 horsepower Alvis Leonides Majors). Handley Page say that this will permit short take-offs. It will also make for long maintenance work.

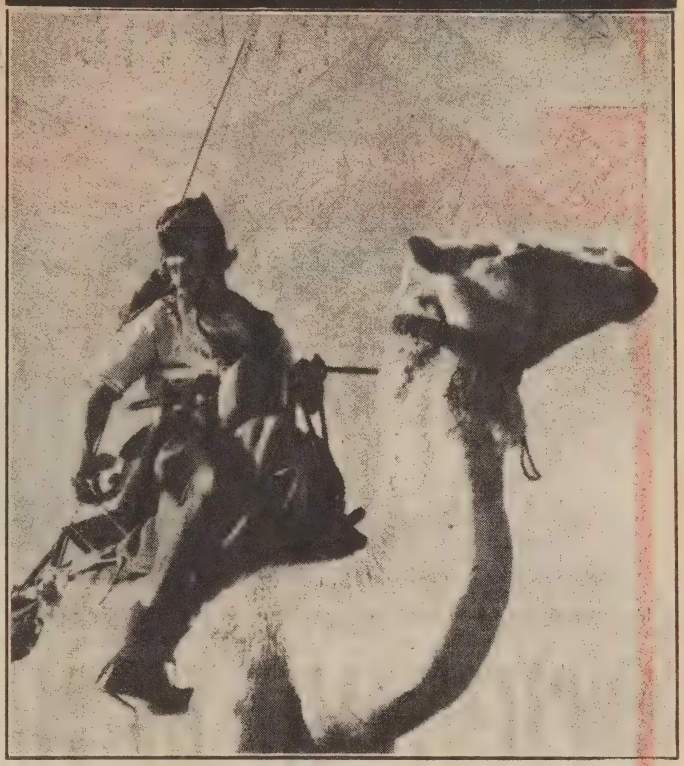
A production-line for 100 aircraft is planned.

HELICOPTERS

Finally, helicopters. There has always been a spectacular display at Farnboroughs since the war, but the impression one gains from seeing the same planes year after year is that there are too many helicopter prototypes and not enough firm ordering to justify them.

Westland Aircraft Limited have had perhaps the greatest success in Britain with their Whirlwind, the licence-built Sikorsky S.55, which British European Airways has used on its 30-minute shuttle service from the air-terminal at Waterloo London to London airport and on the Midland inter-city service. This civil Whirlwind can seat eight passengers and has given me several smooth if rather noisy rides. It can achieve 109 miles-an-hour and has a ceiling approaching 9000 feet.

RADIO PROGRAMMES ON THE HOOF



This wanderer in the desert carries his radio receiver with him—a 3-band worldwide range receiver made by Cossor. It operates from a single dry battery.

RECORD POWER PLANT TEST

THE successful conclusion of a power demonstration by an atomic ship propulsion reactor is reported by the US Atomic Energy Commission.

The first American reactor power plant—land-based prototype of the Nautilus—was shut down at the end of what is believed to have been the longest full power run ever completed by any type of propulsion plant—land, sea or air.

On a single charge of uranium fuel (and using only part of that charge) the nuclear reactor, located at the desert test facility, operated at an average power of 100 pc for more than 66 days and 66 nights. The test was designed to prove the reliability and stamina of pressurised water reactors for ship propulsion. The prototype of the reactor now in the Nautilus met the most demanding requirements which could be placed upon it.

Map made by the famous Greek geographer, Ptolemy. Note the conic projection and the system of climata (length of the longest day).

ANCIENT ART OF MAP MAKING

Millions of maps are in use today—we need them just as badly whether planning an overseas tour or embarking on a weekend car trip. The history of the world's development is largely written in old maps, and any schoolboy knows you cannot find hidden treasure without them.

by Calvin Walters

MAP making is a very ancient art. It has been well said that if we consider history to begin with the written record, then maps are older than history, because the history of them can be traced back to a period before the art of writing was developed.

Primitive people of today can draw maps even though they have no writing. They will, if asked the direction of any place, draw a map in the dirt with a stick.

This is not peculiar to primitive people, for most of us find it much easier to draw a map of direction than to try and explain or write it down.

PICTORIAL URGE

This attribute seems inherent in the human being. It probably sprang from an inborn desire to "doodle", as witness the designs which people scribble on the blotting pad whilst holding a telephone conversation, or the pictures scraped in the dirt with the toe of the shoe while talking on the corner.

Many thousands of people are dependent for their living on the production of maps. This production runs into millions of pounds worth every year.

Maps are used in practically every avenue of life. Schoolchildren use them extensively, as do statesmen, salesmen, engineers, historians, merchants, road makers, warriors and motorists.

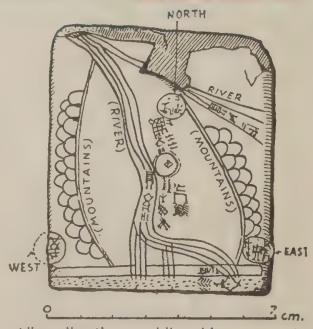
Indeed, there is nobody who at some time or another does not need a map.

An interesting example of primitive map making is the chart made and used by the inhabitants of the Marshall Islands.

Consisting of a frame to which was attached the centre ribs of palm leaves, arranged in a pattern, with shells attached here and there, they constituted a mystery to scientists for a long time.

It was finally discovered that the charts were actually made as a guide to navigation. A picture of such a chart is given here.

The straight lines represent the open sea. The wave front approaching an island is depicted by the curved lines, while the islands are represented by shells. Such charts ceased to be used after the introduction of the European chart about the middle of the nineteenth century.



Allegedly the world's oldest map is this small clay tablet in the Harvard University Museum. Dated about 2500 BC

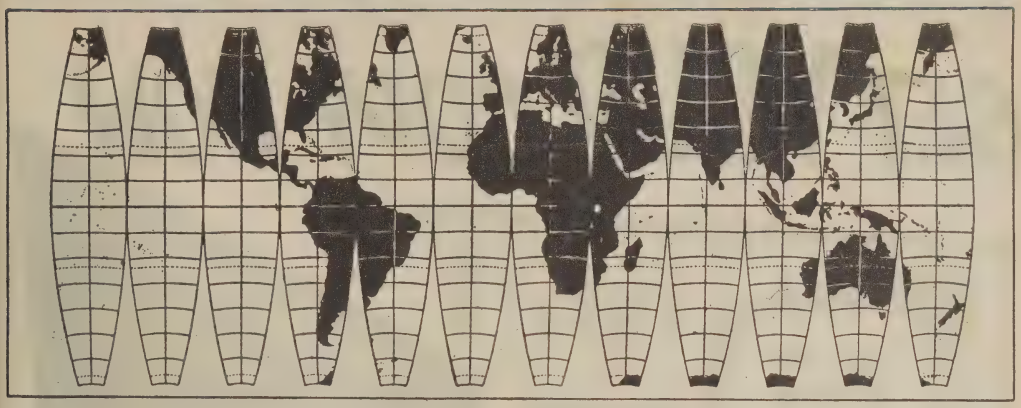


Figure 1.—How the covering of the Terrestrial Globe is obtained.

What is considered to be the world's oldest map is a clay tablet 4500 years old, found in the ruined city of Ga Sur, 200 miles from the ancient city of Babylon.

The tablet is inscribed with a map showing a river valley with mountains on either side. It shows the river flowing through a delta with three lobes into what could be a lake or a sea.

COMPASS POINTS

Circles on the map indicate north, east and west, proving that, even in those days, the cardinal points of what is now our compass were used for aligning direction.

As the Chinese seem to have a hand in developing many of the ideas used today, it is not surprising that they were highly proficient in map making during the early periods of their history.

Long before any Europeans visited China, it had been mapped in detail. This was brought about because the ancient governors and prefects were obliged to make a map of the lands under their control showing the geographic description of land and water in the area.

The ancient Aztec Indians used maps, but these differed somewhat from the ordinary delineation maps by being more of a pictorial record of historic events which occurred at certain places marked on them.

MARITIME MAPS

Needless to say the great maritime nations of the ancient world used maps to guide them through the oceans. Many of these maps were great works of art. Of course nothing was then known about the spherical shape of the earth, it being considered that it was a flat surface floating in the ocean. Nothing was known of latitude and longitude, therefore, maps could be nothing more than pictorial descriptions of areas identified by convenient land marks to guide the traveller.

Early maps depicted such things as stormy areas with pictures of ships sinking in the ocean. Some of them had pictures of rocks with ships wrecked upon them to indicate shoals or reefs and so on.

Medieval maps from the eighth to the fifteenth centuries usually contained an enormous amount of pictorial detail. The most famous of these based on a spherical Earth is the Hereford map of about the fifteenth century.

This map is in the form of a disc with a representation of Christ at the top, symbolically presiding at the Day of Judgment. In the East is the Garden of Paradise, whilst all over the map are Biblical pictures of Noah's Ark, the Tower of Babel and so on.

EARLY MAPS

The outer places of the earth which were little known are shown on the map to be peopled by satyrs, griffins and other fearsome creatures. One such creature is a one-eyed man with an enormous foot, which he uses to shade it from the fierce African sun.

Modern maps are, of course, much more scientifically designed. Our knowledge of the true shape of the earth, its division of latitude and longitude; its climatic zones and so on, together with our familiarity with the oceans, their depths and characteristics, have given us a wealth of material from which the map maker can plot his picture of the earth or part thereof.

A good map should be a delineation on a plane of the surface of the earth or part of it, and which exhibits the lines of latitude and longitude, the shape and extent of all the land surfaces and oceans, rivers, mountain ranges, lakes, towns and roads. It should show the relative positions of countries and their comparative size.

As it is not possible to provide all these on a single map it is usual to make sectionalised maps of smaller areas as required.

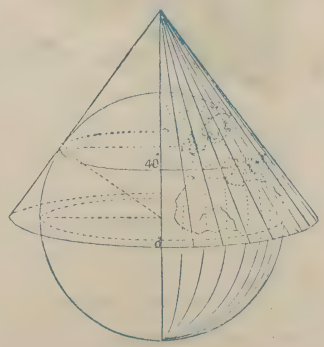


Figure 2.—How a conic projection is made.

THE GLOBE

The truest representation of the earth's surface is the globe. On this, the detail is shown in the correct proportions and shape according to our present knowledge.

The globe, however, is not always a convenient affair to carry around, therefore it is the practice of the map maker to resort to all kinds of expedients in order to get a picture of the earth's surface on to a flat surface in as true a fashion as possible.

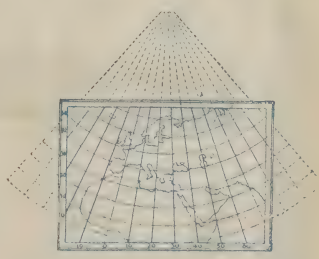


Figure 3.—A completed conic projection.

If you have tried to cover a ball with a piece of fabric or leather you will appreciate the difficulty involved.

Another way of appreciating the difficulty is to take an orange and cut it into attached strips, peeling it off in a single piece which will lay flat.

A globe map is made by covering a sphere with paper. If this paper was peeled off, the map would have the appearance of Fig. 2.

The parallel and meridian system of the earth makes it possible to extend these to a flat surface. This is called "projection."

There are many types of projections but all of them have one common aim—namely, to depict on a flat surface with

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as great an accuracy as possible, the curved surface of the earth with all of its characteristics.

It is obvious from the example of the orange that the surface of a globe cannot be flattened without some distortion. No one has yet found a method of doing so.

Such distortion, therefore, is the one serious problem inherent in any system of flattening the curved surface of the earth. It causes any projection to be fairly accurate in regard to some areas and to render the true shape of seas and continents distorted in others.

An orderly system of parallels and meridians is fundamental to the aim of a projection, for they form the network upon which a map can be drawn.

It is not possible in this article to describe all the methods of projection that have been tried. We will content ourselves with describing in detail two of the better known types to give some idea of the basis of projection.

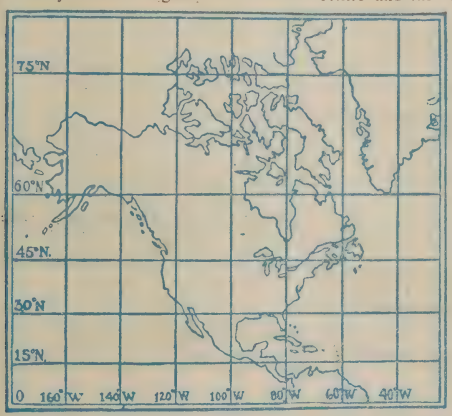
CONIC PROJECTION

The first is what is called a "conic projection". The reason for the name will become obvious as we proceed.

Imagine that the shape of the earth is like two cones, with their bases back to back, as it were, at the equator. A glance at Fig. 3 will make this clear.

Now it is well recognised that, of all solid bodies whose surfaces can be rolled out on a plane without alteration, the cone and the cylinder are the nearest approach to the character of a sphere.

If you look at the globe you will notice that any portion of it between two parallels not far distant from one another is very much like the shape of the same zone on the cone. This will also be seen clearly in the diagram.



Let us assume that you have a globe map with a diameter at the equator of eight inches. If you now take a paper cone with base eight inches and sit it over the globe the base will rest on the equator and it is now possible to mark off the world meridians round the edge of the base. You can also make a mark on the paper at the points where the parallels of latitude would cut the paper if they were projected outwards from the globe.

If now you were to cut the paper down one side from the apex to the base and open it out you would have a surface shaped like the dotted portion of Fig. 4.

By drawing straight lines to the apex from the meridian marks previously made on the base and drawing a series of concentric circles with the apex as the centre and the various latitude marks as radii you now have a conic projection of the globe.

The various land surfaces can now be drawn in to this network. In actual practice this simple conic projection is never used in this original form because the parallels would be spaced unevenly. They would become closer as the pole is approached.

Figure 5.—Portion of a Mercator's projection.

In the conic section actually used the parallels are evenly spaced at their true scale distances.

Conic projections are most useful for making maps of comparatively small sections of the earth's surface. Say, for instance, you wish to make a map of land surfaces between the 30th and 40th parallel. You would use the 30th parallel as the base — not the equator as last described — and draw the meridians from this parallel.

The distortion would not then be easily apparent.

For showing the whole surface of the globe, what is called the Mercator's projection is widely used. This is named after its inventor, the Dutch cartographer, Gerardus Mercator, who lived from 1512 to 1594.

In this projection, it is assumed that

(Continued on Page 119.)

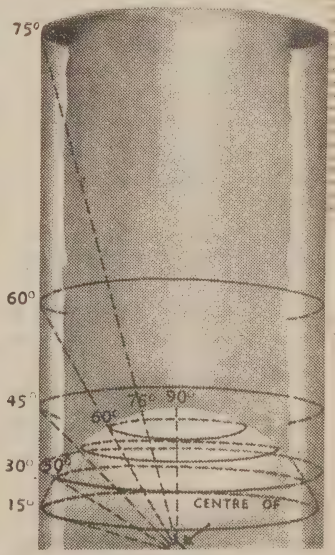
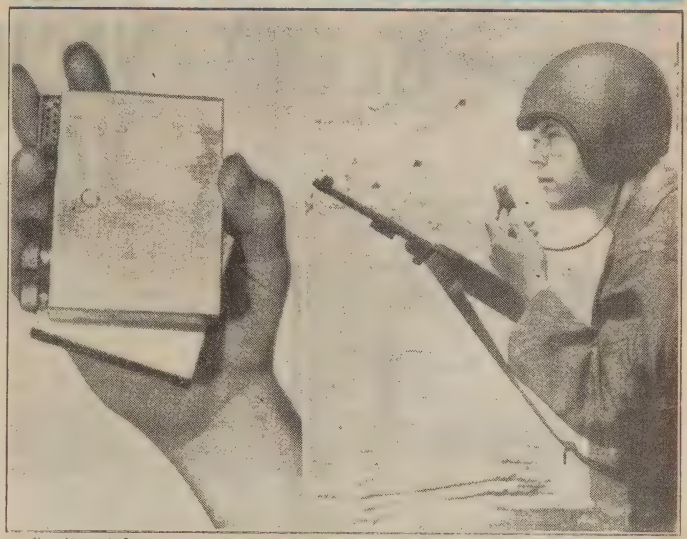


Figure 4.—Mercator's projection principle.

WORLD'S SMALLEST COMBAT RADIO



The United States Army says this is the world's smallest combat radio set. It is built into the helmet, into which the microphone can be slipped when not required. The set itself, shown at left, has two small units, easily held in the hand, and weighing less than one pound, for receiving and transmitting.

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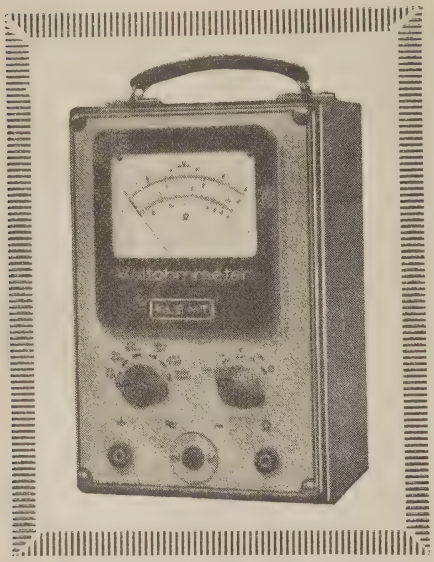

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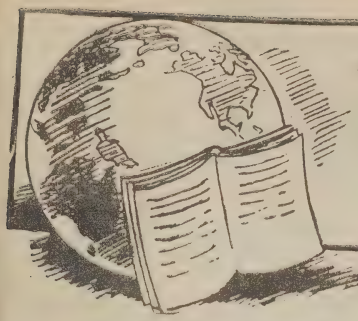

Technical Review

MAKING A TUNING FORK AUDIO FREQUENCY STANDARD

THE amateur Steinmetz is content to measure voltages, currents, and resistances with metering equipment having probable accuracies on the south side of five per cent. A poll of our local ham friends discloses that only one out of ten had a capacity bridge, and that bridge could not guarantee that you could learn the value of a condenser closer than 20 per cent.

Only one of those interrogated had a means of determining inductance values in the RF range and then only by use of a grid-dipper. This technique would, again, require the knowledge of the shunting capacity in order to calculate the inductance.

You will notice that inductance and capacity, which should be known to greater accuracy than resistance, because of the significance of resonant circuits in the electronic art, are actually less easily measured. In the radio frequency range, where stray capacity and lead inductances cloud the picture, we have extremely accurate frequency standards and, while we may not know precisely what the value of the coil or condenser is, we can pinpoint the frequency to which the combination tunes. In the audio frequency range we have less to worry about the effect of stray reactances but who among you owns a precise source of known audio tones?

A visit to numerous ham shacks showed that a surprising number of amateurs had military surplus frequency meters of the BC-221 or LW-11 type.

FREQUENCY ACCURACY

These, and other similar units, in skilled hands, can be practically considered laboratory instruments even though they are far from being primary frequency standards. On the other hand, questioning many amateurs brought forth the fact that their best source of constant audio tone might be a code-practice oscillator or, if they were very advanced, a homemade one-tube audio oscillator with 129 pc distortion and a vague frequency "somewhere near 400 cycles".

We listened to these oscillators. They had the full-throated richness of a Stradivarius with the Formula-21 varnish. Most of them, when keyed, had the delightful frequency variation of a Hawaiian guitar, a musical saw, or a Theremin.

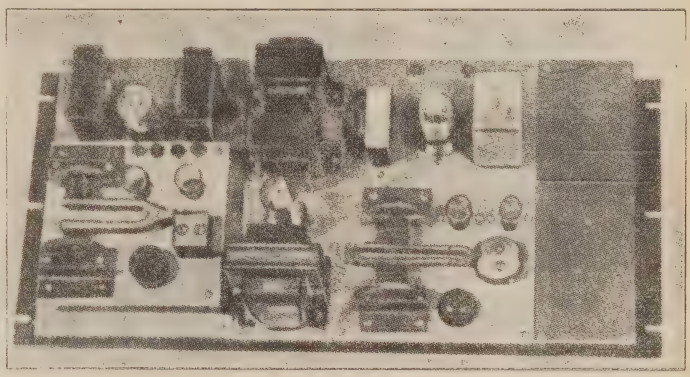

Illustration shows the finished equipment.

The more serious-minded radio amateur who gets more pleasure out of the planning and building of equipment than working DX or rag-chewing, and who enjoys nothing better than to design a complicated piece of electronic gear, is somewhat at a disadvantage, with respect to his commercial brethren, when it comes to measuring-equipment for precision work.

It would be wrong to suggest that such oscillators do not have a purpose for their existence, but we can be certain that their place in the scheme of things does not include serving as a source for precision measuring techniques in the audio frequency range. Now isn't it likely that more radio amateurs would carry their experimentation past the diagram stage if better measuring equipment were in their possession?

PURPOSE OF STANDARD

Why all the fuss about audio frequencies, you ask, when we are already scraping at the microwave doorstep at the other end of the spectrum? Well, for one thing, most of the new and advanced technique presently under investigation, such as single sideband, radio teletype, facsimile, amateur television, etc., require a knowledge or control of audio phase. The phase-shift networks for "sideband" are a good example of the need, not only for stable frequency audio sources, but sources whose frequencies are known within a cycle or two and which will hold within that tolerance for the duration of lengthy tests.

PRIMARY ACCURACY

In radio teletype and facsimile work, where frequency-shift methods are used to convey the intelligence, audio frequency networks and filters are no better than the accuracy of the tone sources employed to adjust them.

Just as quartz oscillators complement tunable interpolating oscillators in RF measuring schemes, it is only logical that adjustable audio oscillators be accompanied by precise spot-frequency sources for any near-scientific work we may want to accomplish. Because of the physical difficulty and expense of constructing accurate single-frequency generators of audio tones that will be equally indifferent to vibration, temperature, supply voltages and aging of components, few of us will venture into experiments requiring small tolerance of frequencies in the voice range.

To tune up and measure the components of sharp audio filters, a tuning-

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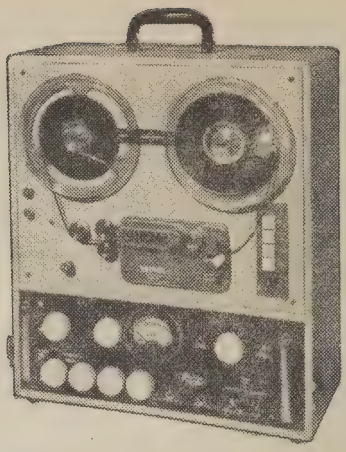

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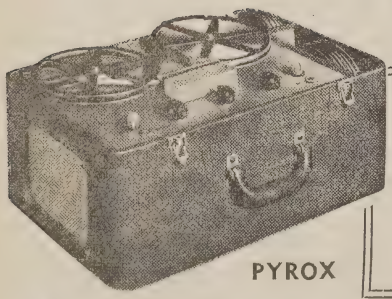

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fork oscillator, built in 1929, was pressed into service and, as a result of a compulsion to improve this device, an entire series of electronically-driven mechanical oscillators, using steel clockspring reeds and tuning-forks was constructed.

One fact emerged from the volume of data collected and that was that even the poorest tuning-fork oscillator was head and shoulders above the best all-electronic audio generator and a close competitor to magneto-striction oscillators. The beauty of the fork oscillator, just as with quartz crystals, is that 99 pc of the accuracy and stability resides within the fork itself and the remaining components have an almost negligible effect on the output precision.

FORK OSCILLATOR

The first tube-driven fork oscillator built by the author made use of a fork taken from an ancient General Radio microphone-actuated mechanical oscillator. The tuning-fork was regarded as something exceedingly precious until a conversation with a musician brought out the fact that very good forks are obtainable from well-stocked music stores and musical supply houses for anywhere from 25 cents to a couple of dollars.

A frenzied buying "spree" came about after acquiring a half-dozen forks at 15 cents apiece. Now that the mental state had worn off, we think it possible that a fork oscillator for every cycle of the audio range was planned (but then we learned about oscilloscopes and Lissajou's figures). Most of the these musicians' "A" and "C" forks gave excellent performances when properly mounted and could be altered over quite a range, by filing, to produce the exact frequency desired.

It was soon found that the best performance was not obtained without some form of amplitude limitation. If adequate feedback is provided so that the fork will start oscillating, then the amplitude will continue building up until the tines of the fork rattle against the pole pieces of the driving coils.

If feedback is reduced, the oscillations will die out completely rather than merely reducing amplitude of vibration. By adjusting the electrode voltages, the tube could be made to overload before the fork amplitude became excessive but this produced an output rich in harmonics and left the vibration amplitude mainly determined by the amount of plate voltage on the tube. When a pure tone was needed the output had to be passed through a filter.

USE OF AVC

Some form of AVC was indicated and the first such assembly used radio receiver methods whereby some of the output was amplified, rectified, and applied as gain-reducing bias to a driving stage. This worked very well, but took a lot of stuff to do the job and was quite bulky.

Not much improvement on the amplitude-limiting circuit was obtained until the arousal of public interest in volume compression and expansion for phonograph amplifiers.

An early form of volume compressor or expander, which later lost favor because of its sluggishness of operation, consisted of a Wheatstone Bridge arrangement having the usual four resistance "arms".

Two of these arms were common resistors while the remaining two were thermally-sensitive resistances. Small pilot lamps were used for the heat-sensitive elements. The amplifier output was fed to two opposite corners of the bridge while the loudspeaker load was connected across the remaining corners.

If the initial adjustment of the common resistances was such that heating of the lamps tended to balance the bridge then volume compression was the result, since no output, regardless of input level, could be obtained at balance.

On the other hand, if the heating of the lamp arms tended to unbalance the network, then the volume of sound output from the speaker went up faster than the increase in signal input and volume expansion was the result.

Application of the lamp-bridge idea to the tuning-fork oscillator made it possible to build up a precision audio generator with amplitude control and needing only a single tube. The sluggishness was no handicap for this purpose, in fact, it is highly desirable.

Once amplitude limiting is provided, the gain of the amplifier can be raised. This enables quicker starting when the power is turned on. There is always a minute amount of room vibration present. This vibration, even though at an extremely low amplitude, generates a small voltage in the pickup coils connected to the amplifier input.

The amplifier output finds easy passage through the greatly unbalanced bridge and drives the fork's other tine with a husky signal. The fork vibration immediately starts to increase which, in turn, passes still more current through the bridge. The lamp arms heat up, altering their resistance in the direction required to balance the bridge.

The fork motion will seek a point of equalibrium where the amplitude remains constant. It may "hunt" for several seconds before steadying down at this level. The amplitude at which stabilisation takes place can be adjusted by making one or both of the non-heat sensitive resistors variable.

GREATEST ACCURACY

The greatest frequency accuracy is had at the point where the work is barely oscillating, generally on the threshold of audibility. At this point the output wave-form is also the closest to a sine wave. Rich audio harmonics at multiples of the fork fundamental can be secured by raising the amplitude level.

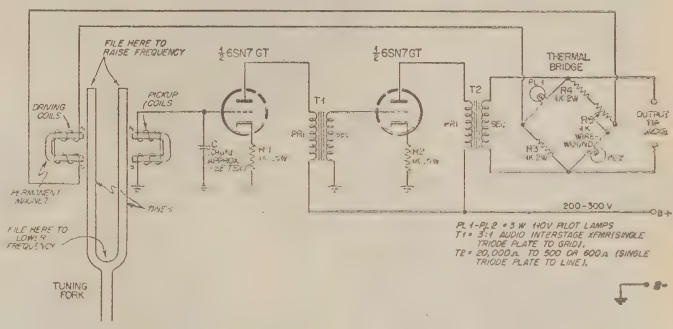
In exceptionally quiet rooms several minutes may be required for the fork amplitude to build up from zero. The sound of a voice can start it instantly.

W2BFD's first need was a 1000-cycle sine-wave generator for capacity and inductance bridge source. With known frequency, the "Q" and dissipation factor dials can be made direct-reading, a great convenience.

One of the author's bridges determines capacity in terms of frequency and resistance. Resistors can be inexpensively purchased giving 1/10 per cent accuracy. Use of the fork oscillator gave similar accuracy in the measurement of condensers.

This 1000-cycle oscillator used the General Radio fork previously mentioned, and the vibrating portions and exciting coils were mounted on a small square of duralumin.

This plate was originally provided with banana plugs so that a series of plates, bearing forks of different frequencies, could be plugged into a single amplifier. With the development of the one-tube circuit there was little economy in this scheme, so the plug-in feature was abandoned in favor of giving each fork its own amplifier. The photo will show the reader that the left-hand unit of the two is the 1000-cycle mechanical oscillator.



Schematic for the super-accurate Tuning-fork Standar

Since the bridge will always be operated close to balance, it was only necessary to make one of the arms variable for amplitude setting. A full turn of this control will produce a hundred-fold increase in output and a quarter-cycle variation in frequency. Except at large unbalances the lamps show no visible light.

CHECK WITH WWV

The smaller tuning-fork, in the photograph, was built from a 440-cycle musical "A" fork which was filed down to 425 cycles and compared with WWV audio tones, using a series of harmonic generators and frequency dividers to develop the correct comparison tone from the (at that time) 1000-cycle transmissions of WWW. This 425-cycle fork has no temperature compensation, yet, under all conditions of room heating the year around, the total frequency error has never reached 1/10 cycle in the numerous frequency checks made over several years. For amateur work this order of accuracy should be entirely sufficient. It represents an accuracy of better than 1/40 of one per cent! The bridge circuit compensates for changes in line voltage, ageing of tubes, etc.

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the more constant will be the amplitude regulation and the more rapidly will fork amplitude build up on starting. As a very effective method of raising gain, and at the same time increasing the purity of the waveform, the pickup coils, feeding the input of the amplifier, are tuned with a fixed condenser to resonance with the fork's natural frequency. Gains of from 3 to 10 times are possible by this trick.

No resonating condenser is employed on the pair of exciting coils because they are heavily loaded by the resistance bridge and do not exhibit resonance. The proper value of resonating condenser is determined with the bridge permanently unbalanced by short-circuiting the lamps and the gain reduced by means of a volume control temporarily connected in the second stage grid.

NEAR RESONANCE

As resonance is approached the gain control can be backed down. The condenser requiring the lowest setting of the volume control is the correct one. The exact value cannot be specified because different coil inductances and different pole-piece-to-fork airgaps will affect it. The volume control should then be removed as the bridge balance control will set the level thereafter.

The construction of the fork and driving units has been left to the last. It is highly important that the fork be fastened rigidly with respect to the pickup and driving coils. Unless the handle of the fork is held by a massive block its "Q" and reliability will be diminished. In the photograph it will be seen that the General Radio 1000-cycle fork is clamped with screws to a rectangular metal block. This was part of the original G.R. setup and was not modified. The musical tuning fork was a horse of a different color as it had no holes through the stem or handle for properly clamping it. At this point we publicly vote our thanks that W2BFD's Welsh ancestor was a Scotsman. A little box had been slowly filling up with tiny scraps of solder, too small to hold without burning the fingers. Instead of melting it down to form an "ingot" of plumbers' bar-solder (hoot mon!) it was dedicated to clamp the fork.

FORK MOUNTING

A bottle of gin was purchased for no other reason (believe us) than to secure the little bakelite "jigger" or measuring cup that serves also as a screw-on cap on the bottle. Setting the cup down, open end up, the handle of the tuning fork was passed through two holes drilled diametrically apart about half an inch up from the bottom of the cup.

After making sure that the tines of the fork lay in a horizontal plane molten solder was poured in, sufficient to cover the handle to a depth of a half inch and allowed to harden, whereupon the bakelite cup was cracked off and two mounting holes drilled down through the "ingot" for clamping to the chassis plate.

The pickup and driving coils, as can be seen, are constructed of the complete "innards" of a cheap pair of 2000-ohm headphones. They are bolted to a couple of pieces of ¾in angle iron or aluminium) about two inches long.

They should be fastened to the angles at such a height that the tines approach the centre of the pole-pieces. An airgap of from 1-32 to 1-16 inch should be about right, depending on the strength of the permanent magnets.

BBC MAN IS WIRED FOR SOUND

PETER DIMMOCK, head of BBC Television Outside Broadcasts, with the radio microphone equipment developed by the Designs Department of the BBC Engineering Division. The actual microphone, about 1¾ inches in diameter, is clipped to his waistcoat and he is slipping the transmitter into his pocket. The transmitter, which is the size of a packet of twenty cigarettes, will operate from a battery pack of about the same size, which can also be slipped into a pocket.

The connections to one set of coils may have to be reversed in order to obtain regenerative feedback. It may also be advisable to try reversing the polarity of the permanent magnet on one set of coils.

It is extremely easy to adjust the final frequency of the fork. To lower the frequency the tines are made longer by filing away metal in the crotch between the tines with a rat-tailed file.

To raise frequency the tines are shortened by filing the tips with a flat file, taking care to give each tine equal treatment. It is best to remove the fork portion from the magnet assembly so that the filings are not collected on the pole-pieces and magnets.

Changing the load on the unit has negligible effect on the amplitude of the output and results in no detectable frequency variation. However, when the load has become too great for the bridge to further compensate, the oscillations will abruptly cease.

A very fine square wave results from turning the bridge balance control full-on. Usable amounts of energy are to be had at harmonics as high as the 20th, which can be separated from energy at other harmonics through the use of tuned circuits or filters. Thus the 425-cycle fork can supply output directly at 2125 and 2975 cycles, the mark and space frequencies of frequency-shift Teletype equipment.

An interesting use for the fork and coil assembly, other than as an oscillator, is as a sharply-tuned receiving filter. The frequency fed into one set of coils must be within one cycle of the fork's natural period for any appreciable vibration to take place. When this is the case a voltage is generated in the other set of coils by the vibration of the fork and this may be considered the output voltage.

Motorola has made good use of this extreme selectivity in their "Vibrasender" and "Vibrasponder" equipment for selective mobile calling. A fork used in this manner is so sharp in its response that it is practically a necessity to use another fork as the source of the tone for it. A number of interesting possibilities open for us in the employment of this principle for remote control and autocall.

MOUNTING

The mounting method is the universal unit-construction, standardised by W2BFD to make life simple. One of a score of similar "universal" power supplies is shown between the two fork units. A unit similar to this setup would be excellent for two-tone tests of single sideband equipment and intermodulation checks on high fidelity audio gear. It is the "last word" as a generator to excite Maxwell, Owen or Schering bridges.—CQ.

acos

A COMPLETE RANGE

CRYSTAL MICROPHONES
MICROPHONE INSERTS

FOR EVERY PURPOSE

DESK or HAND MICROPHONE, MIC36

This Microphone is ideal for home recording and public address, etc. Response unexcelled for its size and price. The performance is not affected by vibration, shock or low frequency wind noise. Omni-directional frequency response substantially flat from 30 to 7,000 c.p.s. Recommended load resistance not less than 1 megohm, dependent on low frequency response. Can be supplied complete with switch and floor stand adaptor, as required, at a small extra cost. **PRICE, £6/18/6.**

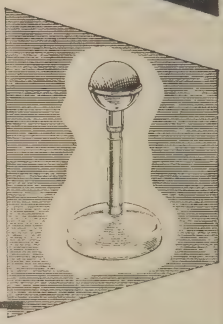
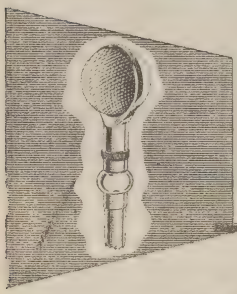


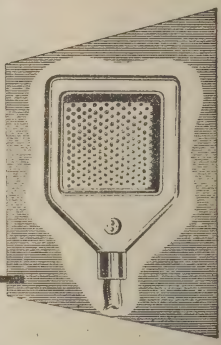
TABLE or STAND MICROPHONE, MIC22

This omni-directional Microphone is robust in construction, with a pleasing appearance. Vibration, shock or low frequency wind noise will not affect the performance. The low frequency cut-off is dependent on the load resistance. The cut-off is given by the equation, F = 80 divided by R, where F = c.p.s., R = megohms An adaptor (floor mounting) is available at low extra cost. **PRICE. £9/18/6.**



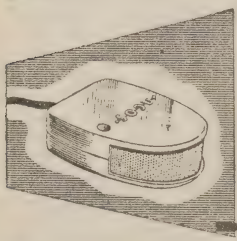
HIGH-QUALITY MICROPHONE, MIC16

This Microphone incorporates the world-famous floating crystal sound cell construction. Its fine performance is not affected by vibration or shock. The fidelity is not impaired by low frequency noise. **PRICE, £24/19/6.**



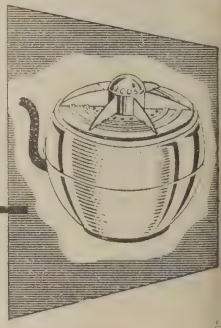
LAPEL MICROPHONE, MIC28

Designed to give freedom of movement, this Microphone is small and non-directional. Housed in a soft, moulded-rubber case, which gives protection against shock, it is provided with a pin at the rear of the case for pinning to the lapel. **PRICE, £5/19/6.**



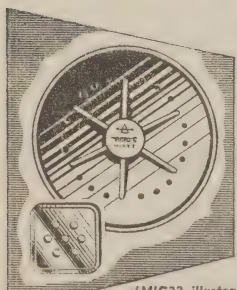
GENERAL PURPOSE, MIC35

The MIC35, is ideal for amateur transmitters, public address, etc. Housed in an attractive die-cast case, it features a high sensitivity and substanially flat characteristics. Provided with a built-in shunt resistance of 2 megohms, it will, when connected to the grid of the input valve, give a substantially flat response from 50 to 5,000 c.p.s. **PRICE, £2/15/-.**



HAND or DESK MICROPHONE, MIC33

This Microphone has been designed for the high quality public address and home recording field. High sensitivity and flat characteristics are obtained by a specially designed acoustic filter. Housed in an attractive plastic case with an unexcelled response for its size and price. Unaffected by vibration, shock or low frequency wind noise. Omni-directional frequency response substantially flat from 30 to 7,000 c.p.s. **PRICE, £6/18/6.**



CRYSTAL MICROPHONE INSERTS

These inserts are available in varying sizes, ranging from as small as ½ in. square to 1-½ in. round, with various thicknesses from 5/32 in. to ⅝ in. Suitable for every purpose, such as hearing aids, public address, tape recording, amateur transmitters, etc., they have responses from 2,250 c.p.s. to 3,500 c.p.s. at -5 db to -30 db. Insert can be supplied with or without 10 meg. resistor as required.

MIC19/4 and MIC32, **£2/15/6**; all others, **£1/19/6.**

(MIC32 illustrated)
(MIC23 illustrated)

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Victorian Distributors: DISTRIBUTORS CORPORATION, 403 Bourke Street, Melbourne.

NEWS AND VIEWS OF THE MONTH

Not much has been published about television in Russia, although it is known that the CCIR 625-line standard is being used and that British firms have filled orders for some equipment for that country. The following notes therefore carry a particular interest.

Russian TV

SOVIET television may look primitive to an American, but in its way it's a good deal more advanced than household plumbing, country roads or some other adornments of this country's much advertised way of life, says the New York Times.

Television entertainment must wait patiently for the leftovers after the Government has allocated the lion's share of Soviet resources to the production of steel, electric power and their heavy industrial brothers.

Like every other medium of mass communication in the Soviet Union, television is a vehicle of Government propaganda. It must, as Soviet publicists say, have "high ideological content" to justify the time and money the regime spends on it.

TYPICAL FARE

A typical evening's fare for the Muscovite viewer begins at 7 o'clock (there are no daytime telecasts except on Sunday and special occasions) with a children's film entitled "The Entertaining Alphabet", designed to help youngsters master the Cyrillic characters, or "Geese and Swans", calculated to teach them multiplication.

At 7.30 there is an abrupt change of emphasis and a solemn-faced young man begins lecturing on "Prospects for Electrification Development in the Sixth Five-Year Plan".

After 15 minutes of electrification, the viewer is treated to a new Soviet film, "The Rumyantsex Affair", in which a wrongly-accused truck driver vindicates himself and "socialist legality", a favorite battle-cry these days.

At 9.15, there is a lecture on a "New Medical Instrument", designed to prove that Soviet medicine is advancing with herculean strides toward the eradication of disease and suffering. The evening concludes with a concert of foreign dance music (something unheard of in Stalin's day) and a film on "Georgian Ballet Masters". Sign-off is at 11 o'clock.

FEW LAUGHS

There are not many laughs in an evening of this sort, but at a TV set registration fee of 33 kopeks a day (about 4d at the official exchange rate) it's considerably cheaper for the set-owner to stay at home than to go to the cinema.

The Kremlin's interest in television as a new medium of propaganda is reflected in its plan to have at least 75 television stations and a large number of relay stations operating throughout the country by 1960. The 13 stations now broadcasting regularly are in Moscow, Kiev, Leningrad, Kharkov, Minsk, Riga, Kalinin, Tallinn, Baku, Sverdlovsk, Tomsk, Omsk and Vladivostok.

There are said to be a total of 1-million television receivers in the Soviet Union today, compared with only 4000 in 1950. The Government promises to manufacture about 1-million more this year.

Technically, Soviet television doesn't compare unfavorably with the American variety, at least as far as the image on the screen is concerned.

Soviet screens are generally smaller than those on American sets. They range from 11 by 14 centimetres (4.4 by 5.6 inches) to 24 by 36 centimetres (9.6 by 13.4 inches).

According to Moskovskaya Pravda, stores in the capital will sell ten types of television sets this year with different screen sizes and exterior finish. They range in price from 1200 to 2400 rubles (£150 to £300) today.

Soviet officials admit they have not solved the problem of color television. They are still debating the relative merits of special color receivers and adapters to be used with present sets. Some adapters are being manufactured.

Zworykin talk on TV

SERVING as an extension of human sight, closed-circuit television will expand greatly during the coming years according to Dr. Vladimir K. Zworykin, television scientist and honorary vice-president of the Radio Corporation of America.

"Apart from the many uses of closed-circuit television in education, industry and research, we can envisage it in many other fields, such as, an aid to the housewife, giving her visual access from the living-room to the kitchen, nursery, play area and entrance way; and to the farmer, providing over-all views of the stables, yards and outbuildings," said Dr Zworykin, in a recent address to the RCA Institute.

"In parallel with the expansion of color television in the United States, there will be a comparable expansion of black-and-white television, eventually supplemented by color television, in other parts of the world. The establishment of international television networks, linking nations and continents, will follow this development closely."

Discussing new laboratory advances, he said that further progress in solid-state electronics will eventually give rise to new methods of television picture reproduction, replacing the cathode ray tube with a wall display, or "mural television".

"The old objective of the fully automated factory, relieving men of purely routine jobs so that their talents may be employed in higher skills, is being realised to an increasing extent through the medium of electronics," Dr. Zworykin stated. "The field of automation presents the man trained in electronics with an enormous variety of challenging problems, whose solution is vital for the continued improvement of our standard of living."

Where's the ball?

AN overseas radio manufacturer has been amusing himself with an electronic golf-ball that cannot be lost.

He has inserted a super-miniature transmitter inside the ball; it radiates a steady signal. The player, in turn, is equipped with a pocket receiver that picks up the signal.

To find the lost ball it's just a matter of walking in the right direction until the signal reaches maximum volume.

An alternative proposal to put more pleasure into the game of golf is to insert a radio-active substance in the core of the ball. Then it would only be necessary to walk around the course with a Geiger counter.

"They want to know how to work out the figures that determine the winning number in a jackpot lottery!" (From the Sydney "Sun.")

AEGIS

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EXTENSION SPEAKER

S.P.5 JUNIOR. An attractive 7in circular moulded plastic cabinet 2in deep with contrasting coloured feet and louvred front grille. Complete with 5in unit (3 ohms input imped.). LESS TRANSFORMER Terminal block for easy connection. In Walnut and Natural only

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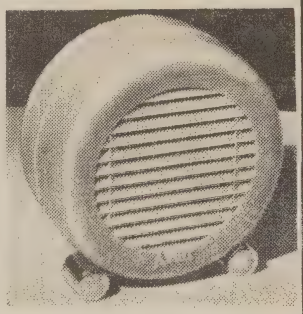
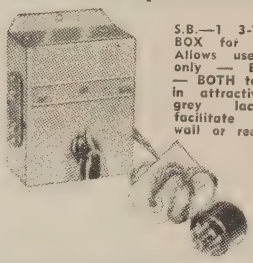


Extension Speaker Control Box



S.B.—1 3-WAY CONTROL BOX for above speakers. Allows use of RECEIVER only — EXTENSION only — BOTH together. Finished in attractive Hammertone grey lacquer. Flanges facilitate attachment to wall or receiver cabinet.

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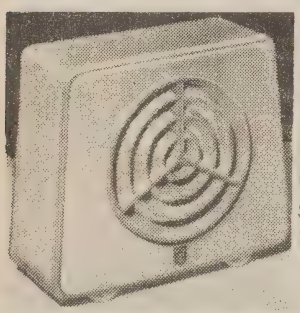

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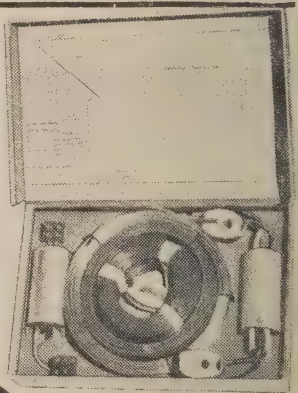

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Red-hot circuits

THE penetration of a critical temperature barrier in the development of guided missiles and supersonic aircraft was dramatically demonstrated recently in New York, when General Electric scientists exhibited laboratory models of revolutionary electronic devices and circuits operating literally "red hot", a major step toward overcoming the inability of electronic control to withstand the great heat generated by air friction at extreme speeds.

Inside glowing electric furnaces and surrounded by blazing blow-torches, vacuum tubes, capacitors, resistors, transformers, inductors, wires, printed circuit boards—and even an electric motor — were operated at temperatures ranging from 900 to 1500 degrees Fahrenheit. Metals such as titanium and special laboratory-designed ceramics play important roles in the design and construction of high-temperature components.

"Hi-fire" phonograph

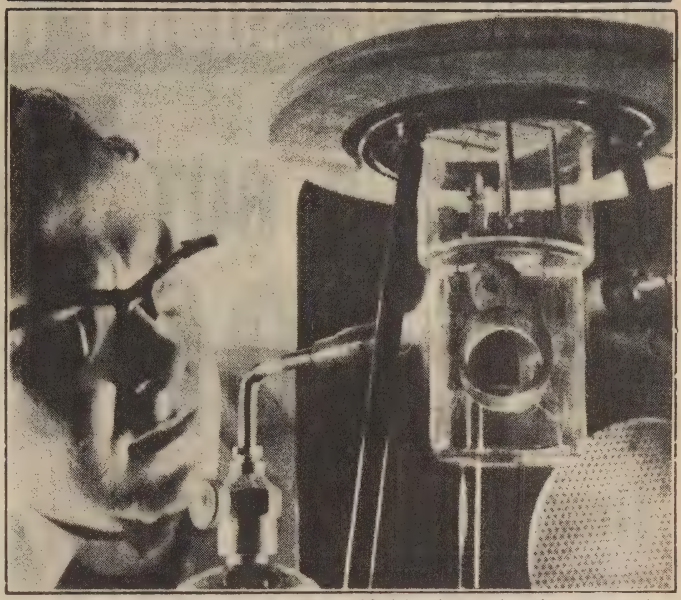
TO help show the versatility of the high-temperature electronic components, GE Research Laboratory scientists demonstrated a "hi-fire" phonograph with the amplifier glowing brightly in a 1500-degree-Fahrenheit oven. There was sufficient volume to fill the large demonstration room and surprising fidelity in reproducing the "hot jazz" record used in the demonstration. Also shown was another circuit that picked up and amplified a radio signal even while the equipment was in the direct flame of three blowtorches.

Other less dramatic, but scientifically significant, demonstrations, included two multivibrator (electronic pulsing) circuits operating in electric ovens at temperatures ranging from 1000 to 1500 degrees Fahrenheit. Both of these demonstrations involved circuits using vacuum tubes, resistors, capacitors, and print-boards, and in one of the demonstrations "heaterless" tubes were used to show that at high temperatures there is no need for the power supply normally required to heat the filaments in the vacuum tubes.

In another demonstration, a unique new high-temperature transformer was shown operating in an oven at nearly 1000 degrees Fahrenheit.

A small motor that runs at similar temperatures was displayed. A strip of solder held against it melted immediately and the application of a blowtorch flame had no effect on the motor's operation.

REDHOT CIRCUIT STILL WORKS



A radio signal is being picked up and amplified by this red hot electronic circuit, the heat being supplied by a blow lamp (see paragraph this page).

POPULAR SCIENCE QUIZ

Q: What is the effect of snake poison on a human?

A: Snake poisons are very complex in their chemical structure and their effect. Broadly, they can be divided into two types. One is hemorrhagic or hemotoxic and acts by causing local congestion, damaging blood cells and rupturing small blood vessels. The other is neurotoxic and affects breathing or heart action . . . sometimes both. Poisons may actually exhibit both characteristics, although one or other predominates.

Q: Speaking of snakes, is it true that a constrictor crushes its victim to death?

A: Experts say that the assertion is only partly true, although the victim may not appreciate the fine difference. A constrictor twines itself around the victim and confines his movements. As the victim struggles and exhales, the constrictor closes his grip and further restricts limb movement and inhalation. Ultimate suffocation is inevitable.

Q: What are the normal frequency limits of human hearing?

A: The limits of hearing, in terms of frequency, vary widely with individuals. At the low end of the register, the limit lies in the region of 15 to 20 cycles per second. At these very low frequencies, there is a tendency for the ear to separate the successive pressure waves into independent phenomena rather than as a continuous sound wave.

At the high end of the spectrum, 15,000 cycles per second would be a fair average figure. Young people, particularly, can often hear higher frequencies than this, up to almost 20,000 cycles per second. The limit normally decreases with advancing age so that many people at middle age and beyond cannot hear even 10,000 cycles per second.

Quite apart from age, the matter of sickness or general health has a bearing on the upper limit of hearing, as also does a person's "history" in terms of ear infections, operations, etc.

Q: Speaking of hearing, is deafness just a general loss of ear sensitivity, like turning down the volume on a radio set?

A: Most definitely not because such a condition would not necessarily affect one's sensitivity to sounds of different frequency, nor would it impair ability to detect loud sounds.

In actual fact, deafness is often frequency selective in that a person becomes more deaf to one portion of the spectrum than another.

Furthermore, deafness is often accompanied by a condition where the person concerned cannot hear low level sounds at all, yet is distressed by loud sounds. Their whole "dynamic range" of hearing is restricted.

These facts produce serious difficulties when designing hearing aids because it is not always satisfactory merely to design a hearing aid as an amplifier. It may have to favour some frequencies more than others, amplify weak sounds, yet not amplify loud sounds to the same extent.

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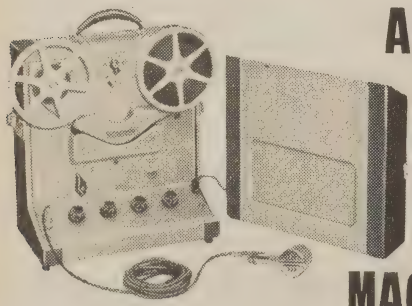

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Australia's Amateurs

RADIO amateurs have at last won some intelligent championship at Canberra, where members of both Houses have recently made a move to obtain new privileges for them.

In last month's issues, we reported a question asked in the Senate by Senator Hannan, concerning the exemption from excise and sales tax for technical apparatus bought by amateurs.

A similar suggestion was made last month in the House of Representatives by the Liberal Member for Capricornia, Mr. H. G. Pearce.

Mr. Pearce went further, and suggested that the Government should raise the power of amateur stations from 100 to 250 watts to bring them more in line with amateurs in other parts of the world.

Both of these ideas are good ones, and can be amply justified.

In the matter of power, a number of representations have been made in the past to the PMG for approval for 250 watts, but in each case they have been resisted.

It is difficult to understand why.

Possible interference with other services has been the most consistent ground for this resistance, particularly in relation with TV sets.

But experiences overseas indicate that amateurs are well down on the list of interference sources, even in America where they are allowed to use an input power of 1000 watts.

Experienced amateurs, who have had a long service on Amateur Advisory Committees which operate under chairmanship of a PMG officer in each State, can vouch for the fact that amateurs in this country rarely interfere with broadcast receivers, even those close by, in such a way that simple cures are not effective.

In America, where there are more amateurs using more power than anywhere else in the world, techniques have been developed which enable any well built amateur station to operate without worrying TV users in its vicinity.

THE GENEVA CONFERENCE

Mr. Pearce also suggested Government assistance for representatives of the WIA to attend the Geneva Conference in 1959, and pay their part in looking after amateur interests.

And why not? Amateurs are recognised internationally by being given their own bands and conditions of operation. Their bands are under continual pressure by commercial interests who would like them for their own use. It is only right that amateurs should be given every assistance to plead their case in person, when, as Mr. Pearce so ably pointed out, their value to the Commonwealth has been demonstrated so often by their patriotic deeds.

As from this issue the price of Radio, Television and Hobbies is 2/-. The new price is necessary because of the higher cost in the publishing industry and because of production improvements instituted for the benefit of our readers.

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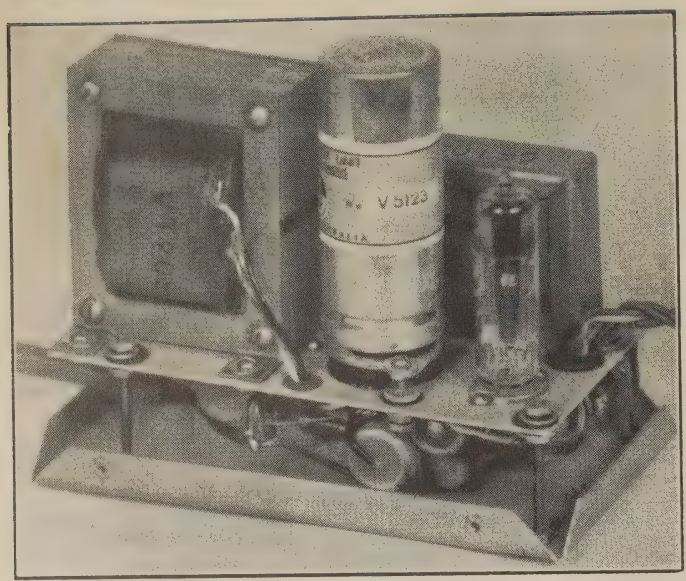
FI33



Complete power supply with cover removed. The LT RF choke is just visible under the base plate, with the primary buffer to the right of it. Note the rubber grommets supporting the vibrator socket bolts and at the corners of the base plate.

KARSET FOR 12-VOLT SYSTEMS

Continuing the description of our Karset which we commenced last month, we discuss the construction of the power supply and its conversion for 12-volt operation. We also describe an ingenious filament network, capable of rapid conversion for either 6 or 12-volt operation.

FIRST the power supply. As with the receiver, the main aim in producing a particular version is to eliminate the possibility of hash, leaving as much safety margin as possible to allow for inadvertent variations by individual builders.

As we mentioned last month, this combination of receiver and power supply (the two cannot really be treated separately) is particularly free from this trouble, and we cannot imagine any readers running into trouble if they follow our instructions carefully.

But that last phrase is most important, and a hit-or-miss approach, or failure to study the instructions carefully, can easily lead to trouble and disappointment. It is often quite surprising how readers can misinterpret written instructions if they are a little careless.

TYPICAL CASE

We encountered a typical example of this only a few days ago, and the story is worth repeating for the moral it contains. A reader rang us to tell of his experiences with a Four-Valve Karset, which had been very unsatisfactory ever since it was first built.

Hash was the trouble, and the owner had fiddled and tinkered with the unit on a number of occasions in an effort to eliminate it, but all to no avail.

He went on to explain that, although he had built the receiver section himself, the power supply had been built by a friend and that this was where he eventually found the trouble. The two buffer capacitors across the transformer secondary had been connected between each end of the transformer and the centre tap, rather than to the common earth point as shown in the circuit.

SIMPLE CURE

Our reader had then rewired the unit to conform with the published circuit, whereupon the majority of the hash disappeared. That which remained was of little consequence, and could probably be completely eliminated, if required, now that the major portion had been dealt with.

by Philip Watson

Just how the builder came to make this mistake will probably never be known. It was probably due to a rather vague idea that a couple of buffers were required across the secondary, without any very clear idea of the exact circuitry.

Alternatively, it may have been reasoned that the centre tap was adequately bypassed, and therefore at "earth" potential as far as hash was concerned. Or, again, it may have simply been a straight-out wiring error.

INTOLERABLE

But, whatever the cause, this is the kind of error that simply cannot be tolerated in projects of this kind. If it is the result of faulty reasoning and a general impression that "near enough is good enough", then we can only emphasise, once again, how vitally important it is to follow the circuit and instructions with the utmost care.

Thus, when components are shown returning to a common earth point, we mean them to do just that, not to be earthed at various remote points which the builder imagines are at the same potential as the one we selected, or to be brought together in twos and threes and then find their way to the selected earth by common leads.

If you cannot grasp the idea that impedance can exist between such "earth" points, and that voltage can be developed across these impedances, then you will just have to take our word for it. But you may rest assured that when we draw a circuit in a particular way, or describe a particular layout, we mean the job to be done that way.

So don't skip the article and don't guess. If you're not sure, read it again.

At first glance it may appear sufficient simply to enclose the vibrator components in a metal box, thus shielding them from the receiver. Unfortunately, it is not quite as easy as this. In fact, the very box which we intend shall function as a shield may easily finish up actually radiating hash signals if we allow hash currents to flow through it!

CONVENTIONAL APPROACH

The usual approach is to mount all the components on a simple chassis or base plate, taking care that all "earth" circuits are returned to a point on it which we call the common earth point. Thus we eliminate any possibility of hash current flowing in either the base plate itself or through any common "earth" leads.

Then we enclose the entire assembly inside a metal box to act as a shield, but we take particular care to see that

the base plate is completely insulated from the box. Once again, the purpose is to ensure that no hash current will flow where we do not want it, this time in the box. If the box is to be bonded to the base plate, this is normally done at the common earth point only.

In addition to all these precautions, we add filters in the form of by-pass capacitors and RF chokes to leads running into or out of the box in order that these leads shall not radiate hash signals.

These precautions are those which we, and others, have established over the years as being essential to satisfactory vibrator operation. To try to get away with anything less is a risky business.

THIS UNIT

From this general picture we come to the more specific one of this particular power supply. As we stated last month we decided to design a new base plate for this unit, though it is possible to use the older design in certain circumstances.

The new design will almost certainly be necessary if it is desired to use a universal transformer, capable of operating from either six or 12 volts. This will have a slightly thicker stack, making it difficult to accommodate on the old plate.

However, if the universal type is not to be used there should be room on the old style plate for all the components. The best arrangement appears to be to mount the 6X4 in the position previously occupied by the chassis-mounting electrolytic, and to take advantage of the new smaller electrolytics by mounting them under the base plate.

An excellent idea of the general layout of the current unit may be obtained from the photographs and we are also presenting a layout diagram similar to that for the receiver. If this is followed there should be no difficulty in accommodating all the components without undue crowding.

The components are all standard types, but a few words about those we used may prove helpful.

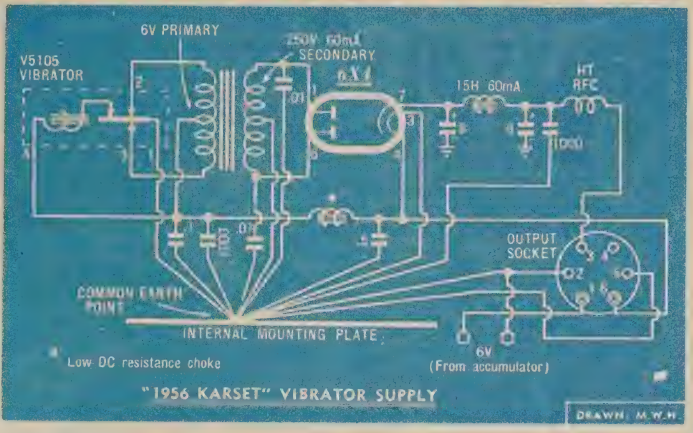
The transformer is a VT-104 for the 6-volt version and VT-209 for the 12-volt version. The exact design of the universal version, as it will be sold, is not yet finalised, but it will probably be designated as a VT-254.

OPERATING VOLTAGE

All these transformers are rated to deliver 250 volts at 60 mA, but this figure is based on a higher voltage input than the nominal voltage of the battery. This is essential to allow for battery charging while the set is in operation. When working from the nominal voltage, as when testing on the bench, the voltage may be around 200 to 215 volts, depending on the amount of resistance in the primary circuit.

The recommended buffer value for the 6-volt transformer is .004 mfd across the whole secondary. We used a .01 mfd across each half, making .005 mfd overall. There appears to be no objection to this slight increase and, in fact, such a procedure is generally recommended by the vibrator manufacturers

CIRCUIT FOR 6 VOLT SUPPLY



The circuit of the vibrator as wired for 6 volt operation. Note that all the buffering is on the transformer secondary, an arrangement which is perfectly satisfactory for low voltage systems. Note carefully the leads running to the common earthing point.

to allow for the increased gap due to contact wear as the unit ages. We will discuss the 12-volt values in greater detail in a moment.

Splitting the total capacitance into two units effectively increases the voltage rating, each unit being rated at 600 volts. Due to the indirectly-heated rectifier, all other capacitors, including the electrolytics, may safely have 350 volt ratings. These latter are easily accommodated underneath the base plate. The two 1000 pf capacitors are a 2 x 1000 pf ceramic unit.

VIBRATOR MOUNT

It is desirable that the vibrator socket be rubber mounted in order to minimise mechanical vibration, which may otherwise prove annoying. The more conventional "manufacturers" or single hole mounting type does not lend itself very readily to such an arrangement, so we used a "replacement" type.

This can be conveniently supported on two ¼in long bolts which raise it slightly above the chassis, the bolts themselves passing through ¼in rubber grommets in the chassis. Brass washers are fitted either side of the grommets to distribute the pressure of the retaining nuts.

SUPPORT BOLTS

The base plate is supported on four 1¾in long bolts which are mounted in the bottom of the shield box. The corresponding holes in the base plate are fitted with ¼in rubber grommets and these rest on a washer and nut assembly approximately 1⅜in from the bottom of the box. Additional washers and nuts on top of the grommets complete the assembly. In this way the base plate is completely insulated from the support bolts.

Note that one of these support bolts has been shifted slightly from its conventional corner position, a procedure which provides extra space for the larger universal transformer.

In considering the 12-volt version of the Karset there are two possible approaches. One is simply to build or convert to the 12-volt version, and the

PARTS LIST

(Power supply only)

- 1 Karset Power Supply box
- 1 Base plate. Old or new style as required. See text.
- 1 Vibrator transformer. Sec. 250V 60 mA. Prim. 6v, 12V or universal as required See text.
- 1 Filter choke 15H. 60 mA. CF-102 or similar.
- 1 Vibrator. V5105 (6v) or V5123 (12v) as required
- 1 6X4 valve
- 1 7 pin miniature socket
- 1 4 pin replacement type socket
- 2.8 mfd 350V electrolytic capacitors
- 1 .5 mfd 200V paper capacitor (2 for 12V version)
- 1 .1 mfd 200V paper capacitor
- 2 .01 mfd 600V paper capacitors
- 2 .005 mfd 600V paper capacitors (12V version only)
- 1 2 x 1000 pf ceramic
- 1 42-45 ohm 3W resistor
- 1 21-25 ohm 3W resistor
- 1 LT RF choke PC2 or similar
- 1 HT RF choke
- 1 3 terminal tag strip
- 1 7 terminal tag strip
- 1 Doz. ¼in rubber grommets
- 1 cable type fuse holder and fuse
- Automotive lighting cable for LT circuit
- 4 1¾in RH bolts, ¼in plain washers, lockwashers, nuts etc.

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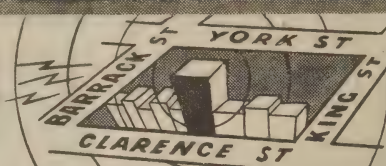

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5C Oval 3.5 ohm V/C	£1	9	11
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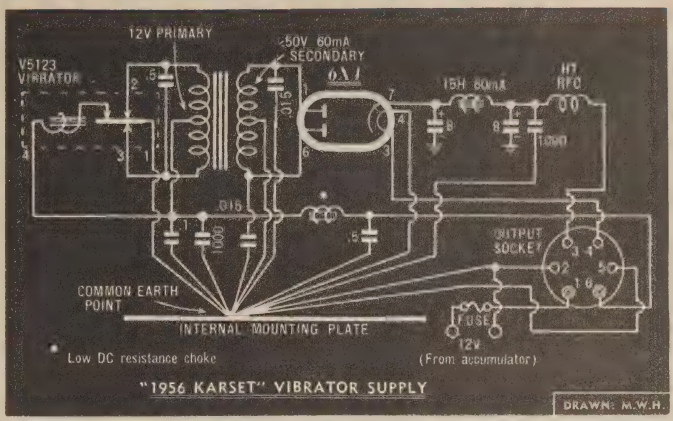
CIRCUIT FOR 12 VOLT SUPPLY



The 12 volt arrangement. Compare it with the circuit on the previous page. Changes to be noted are: the transformer type, the vibrator, the buffers (primary and secondary), and the 6X4 filament wiring. The divided buffering is necessary in some 12 volt systems.

12 VOLTS LATER?

If, on the other hand, the set is to go into a 6-volt car initially, there is much to be said for making the universal version. Since virtually all manufacturers are now standardising on 12-volt electrical systems there is always the possibility that the owner may wish to transfer the set to a 12-volt car at some time in the future.

If designed simply for six volts it is likely that the expense and trouble of subsequently converting to 12 volts may not be justified. However, if this possibility is considered now, the set may be made as a universal version at virtually no extra cost and only a little more trouble. As such, it is unlikely ever to become obsolete.

The above considerations will apply to each of the major components we are about to discuss. We will assume that the reader has already made his decision and simply present the various procedures required for either 12-volt or universal operation.

In order to change from six to 12-volt operation the following changes must be made: Change the vibrator transformer, or change the tappings, if a universal type. Change the vibrator cartridge. Change the filament wiring or change the valves. Change the buffer capacitor values. Add a primary buffer.

THE TRANSFORMER

Taking each of these items in turn, we will discuss the transformer first. In place of the six-volt transformer you will require either a 12-volt version, such as the VT-209, or a universal type. The latter will be slightly larger, but should be easily accommodated. Select the appropriate tappings as specified by the manufacturer.

Unused tappings should be carefully insulated with tape or insulated tubing and wound up neatly out of the way. They should not be cut off short. In the case of the six-volt tappings, the transformer would be rendered inoperative, since the tappings are normally loops in a continuous winding. In any case, leads cut short now can cause inconvenience in the future.

There is not much to say about the changing of the vibrator, except that there is no help for it. There is not much to be gained in trying to operate the driving coil through a resistor, due to the difficulty of ensuring reliable starting. In any case, it is likely that by the time this change is to be made, the vibrator will have given a reasonable number of hours' service, and there should not be too many regrets about replacing it.

Next the valves. If only 12-volt operation is required it would be possible to substitute a complete set of 12-volt equivalent types without any alteration to the wiring. These valves are standard types, readily available, and have the same type numbers except for the prefix number "12" instead of "6" (12BA6, 12BE6, &c.).

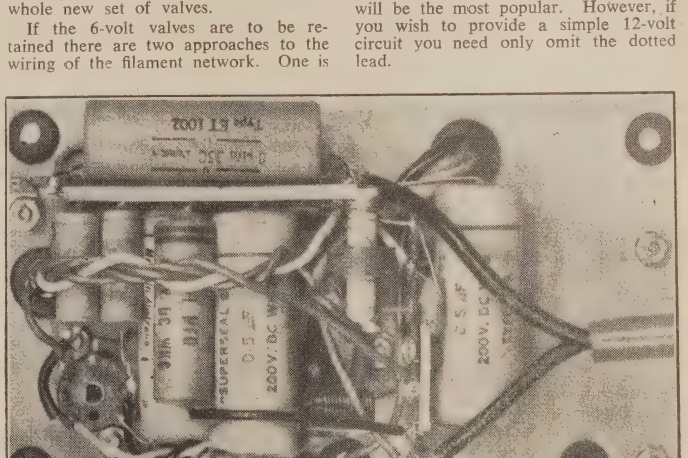
STUCK WITH THEM

However, due to the need to retain the same seven-pin base, it is not possible to provide a filament centre tap (as with the 12AT7, &c.), to give universal six or 12-volt operation. Thus, having invested in a 12-volt series, there is no way of converting the set to 6-volt operation, short of substituting a whole new set of valves.

If the 6-volt valves are to be retained there are two approaches to the wiring of the filament network. One is to use a conventional series-parallel arrangement which is suitable only for 12 volts. The other is to add a few extra wires to this arrangement and make it universal — suitable for either six or 12 volts.

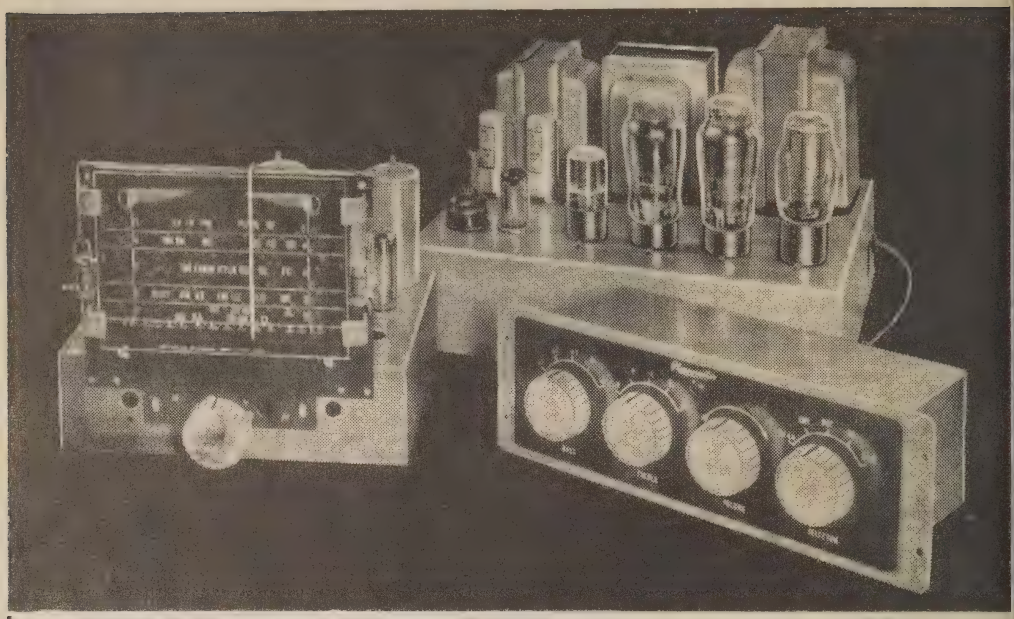
We have worked out a circuit for the latter arrangement which allows the system to be changed from one voltage to the other by simply changing over one lead and adding a link between two terminals. The whole process would not take more than a couple of minutes.

We have shown a circuit for the universal network, since we think this will be the most popular. However, if you wish to provide a simple 12-volt circuit you need only omit the dotted lead.



The vibrator as seen from the underside, wired for 12 volt operation. The .5 mfd capacitor near the centre is the primary buffer. It can be omitted for the 6 volt version. The 6X4 socket is on the right and the buffer capacitors just below it. Compare this picture with the diagram on page 37.

PLAYMASTER



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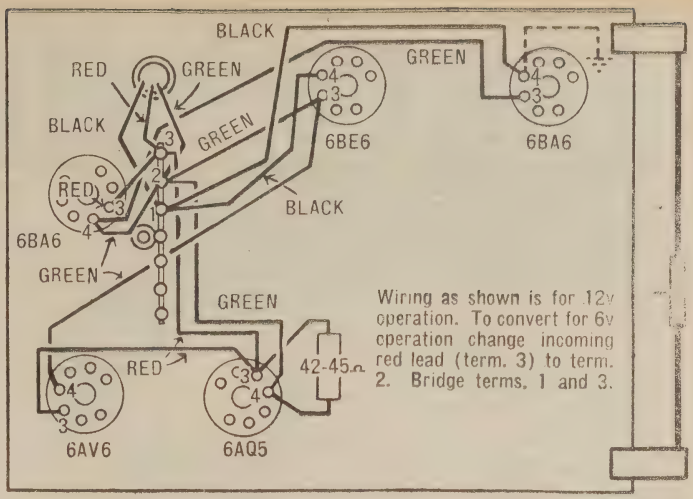
On the more practical side we decided that a wiring diagram of this network was justified. Although quite a simple arrangement in circuit form, series parallel networks are not the easiest things to convert in practice and the extra diagram should prove helpful.

For the same reason we strongly advise the use of three different colored leads—say red, black, and green—for the active, "earthy", and centre tap leads respectively. And finally, although it really doesn't matter in the electrical sense, we suggest you follow the pin numbers in the diagrams.

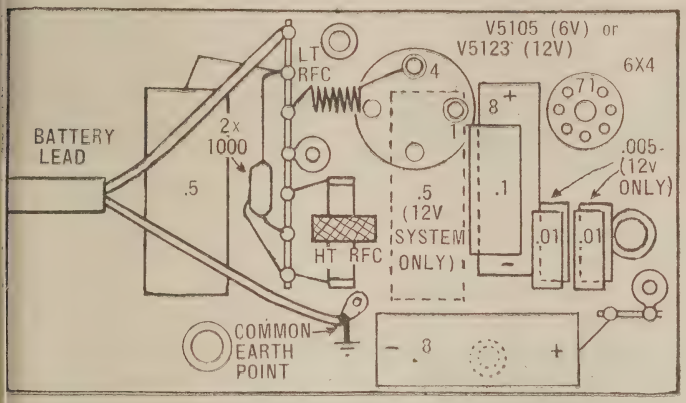
EXTRA LEAD

The 6X4, being in the other unit, will need an extra lead to bring it into the network. Fortunately there is an unused pin in the plug and socket assembly connecting the two units and it is easy to provide a six-way cable instead of a five-way. Even if you have already plaited a five-way cable (as we had) it is quite easy to add an extra lead without undoing everything.

Using a length of wire several inches longer than the finished cable, feed this into the cable at the centre, pairing it with the odd single lead already in use.



This wiring diagram should assist you to wire the filament system for a universal network. The use of colored wires as shown will avoid confusion and is strongly recommended. Note the earth at the 6BA6 RF socket and which may be needed to eliminate hash. It must be direct — not to the centre shield.



A layout diagram for the power supply. As shown it is for 12 volt operation. Omit the .5 mfd (centre) for 6 volt operation. Note the common earth point to which all earth leads should be returned. The exact location of this point is not critical, but the correct return of leads to it may be.

To accommodate the additional filament wiring some extra terminals are required. We provided these by removing the three-terminal tag strip used for the 1 meg AVC resistors, replacing it with a seven-terminal type. A new mounting position is required, meaning that a new hole has to be drilled in the chassis. This should be so located that three terminals of the new strip coincide with the terminals of the old strip and do the same job. The three terminals on the other side of the mounting lug are used for the filament circuit.

TERMINAL LAYOUT

Of these three terminals, the centre one should be used for the centre tap of the filament network and the two outer ones for the active and "earthy" leads. Then, for 12 volt operation, the two incoming leads are simply wired to these two outer terminals and the centre one ignored. Naturally, the correct phasing of active and earthy leads should be observed.

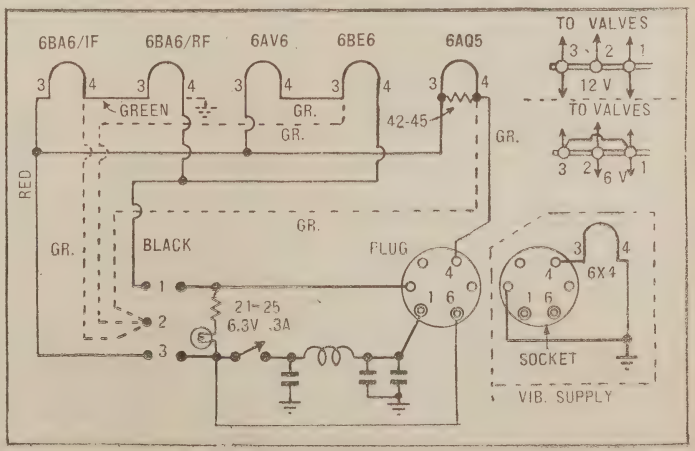
For 6-volt operation the active lead is

Use this wire as a guide and thread the new wire into the cable while running it parallel with the old one.

6AQ5 SHUNT

To match the current drain of the 6X4 (600 mA) it is necessary to shunt the 6AQ5 (450 mA) to take care of the extra 150 mA. This calls for a resistor of 42 ohms, though one a little higher, say 45 ohms, may allow for the resistance of the lead between the two units. It should be a three watt type and may be most conveniently mounted across the 6AQ5 socket.

When the filament network is wired for 6-volt operation this resistor is not strictly necessary and may be omitted. However, it is important that it be fitted if ever the system is converted to 12 volt operation and, if there is any chance that it may be overlooked, it would be wiser to leave it in place. The extra 150 mA drain is not likely to worry anyone.



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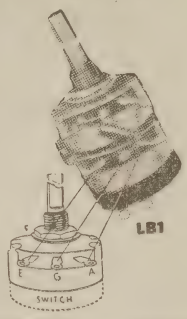

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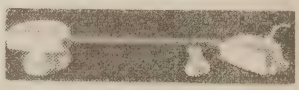

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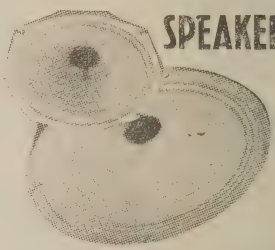

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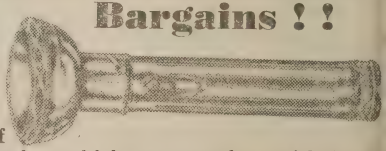

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THE RADIO SPECIALISTS

noved to the centre terminal and the wo outer terminals bridged together.

It is just possible that this modified iring may introduce a small amount f hash, particularly if the leads are not wisted. This can be eliminated by arthing the filament line at the 6BA6 F socket. The earthy contact (pin 4) hould be earthed DIRECT to the earth oint at this socket. DO NOT earth to the central shield of the socket.

While on the subject of filament cir-uitry there is also the question of the ial lamp to be considered. There ap-ears to be two approaches; the use f a 12-volt dial lamp, or a 6-volt type ith a dropping resistor. The use of two amps in series does not seem to be a ood proposition, since too much light an prove distracting.

Twelve-volt dial lamps are available, hough not as readily as 6-volt types. Iowever, it seems likely that this posi-ion will improve with the increased de-nand created by 12-volt car systems. f the alternative is unavoidable a re-istor of between 21 and 25 ohms will erve to operate the 6-volt lamp. It hould be of 3-watt rating.

BUFFERING

The next point is the buffering of the 2-volt vibrator transformer. The nakers recommend a value of .008 mfd ight across the secondary and initial hecks seemed to confirm this value. Iowever, it did appear that a slightly arger value could be tolerated, or was ven desirable, since allowance should e made for the inevitable wear on the ibrator contacts.

By providing a value of .02 mfd cross each half of the secondary we ncreased the .008 mfd to .01, and, this eemed to be an ideal arrangement, par-icularly as it used readily available apacitance values.

Unfortunately, when we brought the omplete receiver into operation again, /e encountered a most severe hash level. t did not respond to the usual reme-ies and we attributed it, initially, to he altered filament wiring.

However, by disconnecting the fila-ent line and operating the cathodes on stored heat" for a few seconds we es-ablished that the trouble appeared to e coming from some other source.

The HT supply was the obvious sug-estion and this was confirmed by tem-orarily substituting an AC power upply. When this eliminated the hash /e knew we were on the right track. A outine check of the components and iring in the HT system failed to show nything faulty, the unit, apart from the ransformer, being exactly as it was for he 6-volt system.

THE CLUE

The fact that the transformer had een changed eventually led us to the olution—the fitting of a .5 mfd prim-ry buffer in addition to the existing econdary buffers. This completely eli-inated the hash and, as with the 6-volt ersion, it was possible to operate the wo units side by side, unshielded, with o interference whatever.

The story behind the primary buffer-ng is quite an interesting one, though ther too involved to cover in detail ere. In a future issue we may devote

(Continued on Page 101)

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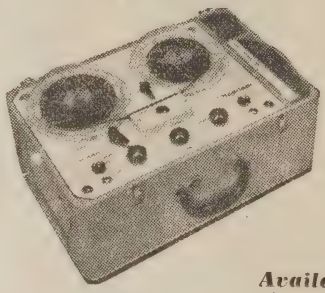

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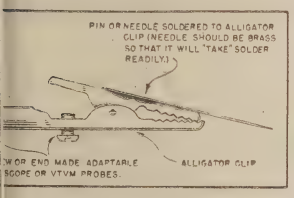
FROM THE SERVICEMAN WHO TELLS

What do you know about printed circuits? In particular, what do you know about servicing them? In fact, can they be serviced at all? With the advent of TV, printed circuits appear to be inevitable and many servicemen are asking the above questions. The following discussion may help to answer some of them.

VO facts prompt me to discuss this subject. One is the presence on workbench of a pamphlet on this subject and the other an announcet that at least one Australian manurer is preparing to manufacture ted circuits for the Australian radio television industry.

he pamphlet, issued by Admiral of tralia (Pty.) Ltd., is on the service repair of printed circuits, and I id the contents extremely interest- By permission of the above organi-on, therefore, I propose to present e extracts from it, hoping that you also learn something from it.

irst, however, a couple of general arks. A popular belief, and one that ave seen quoted in semi-technical les from overseas, is that printed its cannot be repaired. When a occurs (it is claimed) the service- simply removes the offending plate throws it away, together with (preably) whatever good components ain along with the faulty one. Then


PIN OR NEEDLE SOLDERED TO ALLIGATOR CLIP (NEEDLE SHOULD BE BRASS SO THAT IT WILL "TAKE" SOLDER READILY)
OTHER END MADE ADAPTABLE TO SCOPE OR VTVM PROBES.
ALLIGATOR CLIP

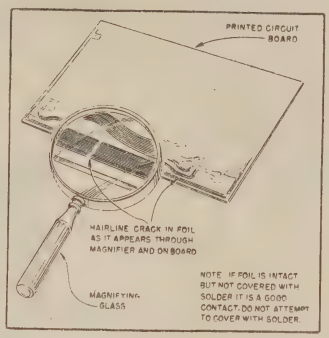
make satisfactory connection to printed foil a "needle-point" probe recommended. An ordinary alligator clip can be converted to such a probe as shown above.

supplies and fits a complete new

can't say the idea ever appealed to . The suggestion that one should erately discard (say) a couple of transformers and their associated ponents, simply because one resistor apacitor, or even one of the IFs had failed, runs completely con- to my Scottish ancestry. Further, spect that a remarkably large numof my customers would discover they, also, were of Scottish descent, ced with the need for expensive rements as described above.

am glad to be able to report, there- that my ancestors may rest easy eir graves. No such mass discardot perfectly good components or eful expenditure of "bawbees" is mplated.

n the contrary, there appears to be eason why any component, from humble resistor to the most com-


PRINTED CIRCUIT BOARD
HAIRLINE CRACK IN FOIL AS IT APPEARS THROUGH MAGNIFIER AND ON BOARD
MAGNIFYING GLASS
NOTE: IF FOIL IS INTACT BUT NOT COVERED WITH SOLDER IT IS A GOOD CONTACT. DO NOT ATTEMPT TO COVER WITH SOLDER.

A possible fault occasionally encountered with printed circuits is the "hairline crack"— a very fine break in the copper foil. It is usually visible under a simple magnifying glass as shown above.

plex coil or transformer, should not be replaced in almost exactly the same manner as in a conventional receiver. I say "almost" because it must be admitted that the technique is different and, in some cases, probably less convenient; yet not such as to render such replacements uneconomical.

In case you have never seen a printed circuit I must say that they are intriguing devices. I have one beside me at the moment, being a sample from the Australian manufacturer who is at present preparing to manufacture these. This fact in itself should serve to emphasise the proximity of the new technique.

The printed circuit commences life as a sheet of laminated plastic (similar to that used for resistor mounting strips, though probably of better quality) to which is bonded a sheet of very pure copper about 1.5 thousandths of an inch thick. Then, by means of various photo-etching processes, large areas of the copper are removed, leaving only thin strips which become the conductors between various points.

Holes are punched in the plastic base to accommodate the components, these being normally mounted on the side opposite the wiring pattern. The pigtails or connecting lugs pass through the holes, are bent over on to the copper strip, and soldered.

In mass production the soldering is performed by spraying the entire board with flux and then immersing it in a solder bath held at optimum temperature. (About 450 to 460 degrees Fahrenheit, I believe.) As a result the entire copper pattern is tinned and all the joints completed automatically.

While this may sound like leaving a lot to chance, I understand that faulty joints are extremely rare; much more rare than for hand operation. In fact, the figure is so low as to be virtually negligible, resulting in substantially greater reliability than is available by conventional assembly techniques.

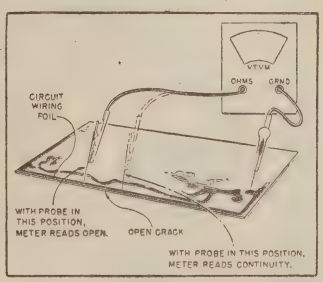
On the other hand, joints can be made manually if so desired and I have already tried my hand at a few on the sample plate I mentioned. Using only standard cored solder and a conventional iron I experienced no difficulty, the copper taking the solder perfectly. No cleaning or additional flux appeared to be necesssary, and there was no suggestion of damage to the thin copper foil.

Nevertheless, this would appear to be the major hazard. The application of too much heat can blister the bonding material, causing loss of adhesion between it and the copper, with the result that the copper "lifts".

"UNMAKING" JOINTS

While it is apparently easy to make soldered joints without applying more than a bare minimum of heat, the real problem appears to be to "unmake" them while observing the same precautions. The methods of doing this, for a wide variety of components, form the basis of the article I am about to discuss.

Under the heading "Precautions To



Hairline cracks can also be detected by means of an ohmmeter, the probe being moved along the suspected strip of foil until lack of continuity reveals the fault. The magnifying glass may be used to confirm the indication.

Be Observed When Servicing" the Admiral pamphlet makes the following general remarks:

"Printed circuit receivers can be more easily repaired if certain precautions are observed. Standard components are

Superior performance at low tape speeds

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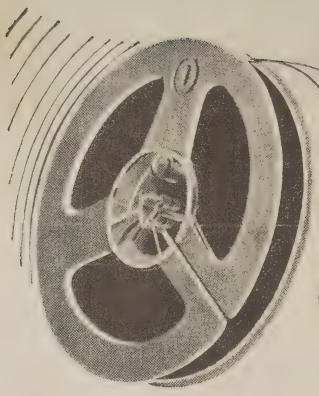

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d throughout and can be removed
l replaced by any serviceman. No
cial tools or skills are necessary.
wever, those parts which have special
unting and connection lugs should
replaced with exact duplicate parts.

'AVOID DAMAGE TO COPPER
IL. Be careful when removing com-
nents from the board. However, if
copper foil wiring is damaged a
ce of wire can be used to replace
damaged foil. Small breaks can be
nped' with molten solder. Larger
aks can be repaired with ordinary
okup wire. It is unnecessary to re-
ce the entire board because of foil
akage.

'AVOID DAMAGE TO PRINTED
RCUIT BOARD. Do not apply ex-
sive pressure to the printed circuit
ard or components. Although the
ard is sturdy in construction and
unting, it may crack or break if
per care is not taken when servicing.
extremely rare occasions, access to
nponents on the board may be diffi-
t. In this case the board may be
noved from the chassis by removing
mounting screws and unsoldering the
leads between the board and the
assis.

"When this is done, a vise with pro-
ted jaws should be used to hold the
ard while servicing and care should
taken not to exert excessive pressure
ainst the board.

"BRUSHED PARTICLES. When
ishing off melted solder"—(more
out this in a moment)—"small par-
les of solder may stick to the board.
fore installing a new component re-
ve these particles with a cloth dipped
solvent. See item (6) under 'Tools
d Materials Required'.

"EXCESSIVE SOLDER DEPOSITS.
some areas on the printed circuit
ard the wiring is very closely spaced.
hen resoldering a new component,
oid excessive deposits of solder. Ex-
sive solder may cause a short or an
ermittent to occur later, which may
difficult to locate.

AVOID OVERHEATING. When
ng the soldering iron (35 watts or
s) do not overheat the component
minals or the copper foil. Excessive
at (applying soldering iron longer than
cessary, using a higher wattage solder-
g iron than recommended, or using
'quick-heat" iron) may cause the bond
tween the board and foil to break.
is will necessitate replacement or re-
ir of the foil connection.

"TOOLS AND MATERIALS RE-
UIRED.

(1) Low wattage soldering iron with
all point or wedge. (Rating should
t exceed 35 watts.)

(2) Small wire brush.

(3) 60 pc tin, 40 pc lead, low tempera-
e resin-core solder.

(4) Thin bladed knife.

(5) Small wire pick, or soldering aid.

(6) Solvent for the Silicone Resin.
commended solvents are Xylene or
natured alcohol, which are available
m the larger chemist shops or
mical supply stores."

Most of the above points are, after
only common sense when one
nes to analyse them and I imagine
uld have been observed by most of
as a matter of course. Of most in-
est are the specific limit placed on
wattage rating of the solderin iron,
type of solder, and the solvent recom-
ded for cleaning the board.

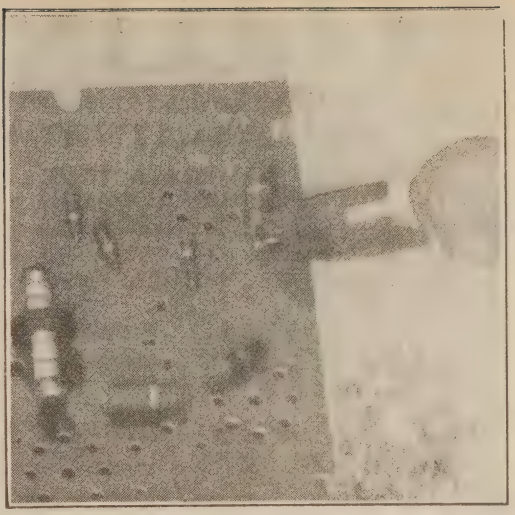
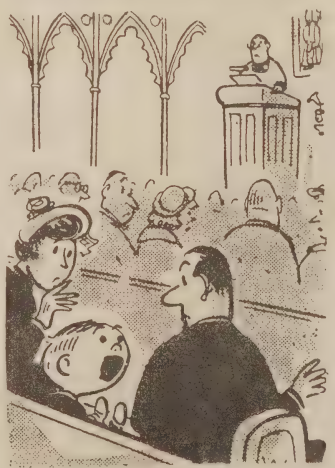


Figure 1. One way to replace a faulty resistor. The pigtail is cut as close to the body of the component as possible, leaving sufficient lead to attach to the new component.

The type of iron which immediately comes to mind is a very small—less than a ¼in diameter shaft—low voltage type which is readily available on the Australian market. In addition to having desirable physical characteristics it is rated at only about 12 watts, thus providing a good margin of safety.

The solder is perfectly standard, a 60/40 alloy having been adopted by the radio trade a long time ago. In addition to a low melting point it has the desirable feature of quick setting, avoiding the protracted semi-fluid condition which characterises other alloys when cooling.

However, it would appear that some form of "activated" flux, distinct from the plain resin sometimes encountered in cored solders, is really essential in order to ensure a rapid joint without prolonged and, therefore, dangerous heating. The "silicone resin" referred to above is one such flux.



"Daddy, is this the commercial?"

The solvents recommended are intended to dissolve these activated fluxes, since any spot of solder adhering to the board will almost certainly be held in place by a film of this substance. In the absence of anything better, ordinary methylated spirit appears to be quite satisfactory. The local manufacturer of printed circuits has also given it his blessing.

By the same token, there would appear to be no objection to dousing a joint with spirit if it was desired to cool it rapidly. This technique has been used extensively in the past to protect some types of plastic insulation against excessive heat.

Incidentally, I am a great believer in the properties of methylated spirit. Not, I hasten to add, as a beverage, but simply as an all-round workshop solvent and cleaning fluid. It is not nearly as dangerous as petrol and similar products, yet it does most of the things they will do.

It is ideal for removing surplus flux, either resin or paste types, which may have splattered in undesirable places. Also, on those occasions when one wants to clean up a salvaged component it will shift grease, dirt, and flux with little danger to the electrical properties.

FIRST AID FOR WATCHES &c

It is also recommended by watch and camera mechanics as the best emergency treatment if one should be unfortunate enough to drop either of these devices in the water. It is better than petrol, since it mixes with water and allows it to be washed away.

Finally, it is one of the few things that will shift the particularly viscous concoction used in ball-point pens and which one invariably manages to smear on the front of a good white shirt. Naturally the quicker the application the more chance of success.

You will note that I referred to the fluid as "spirit", not spirits. I do this from a habit instilled into me by my old science teacher. "Spirits", he used to say, "are things one finds in a cemetery at midnight. The stuff in the bottle is 'spirit'."

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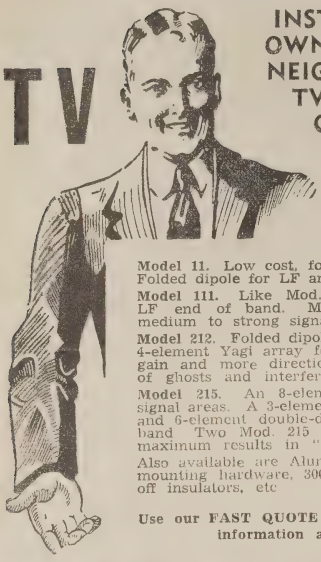

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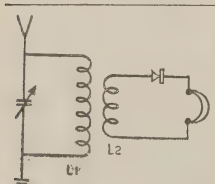

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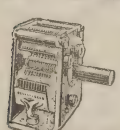

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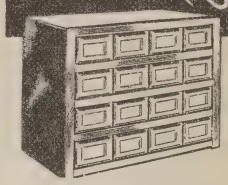

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In THIS ALL-STEEL HANDY CABINET

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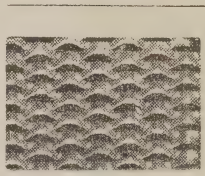

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Suitable for speaker grilles, e can be used natural, or spray any color

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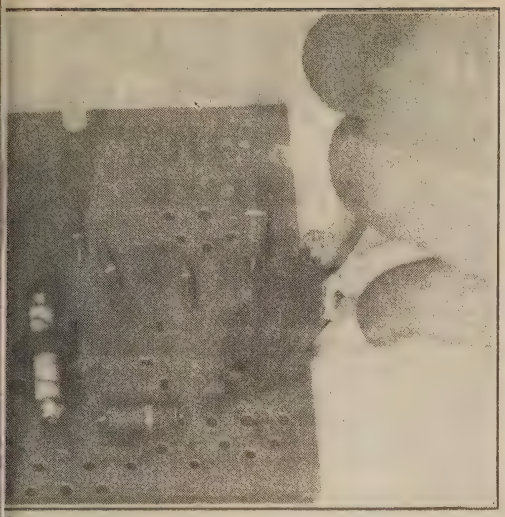

Figure 2. Where the remaining lead is likely to be too short the following procedure should be adopted. First, cut the faulty component in halves.

Figure 3. Then cut the component away from the lead, salvaging all the lead inside the component. Note the lead to the right of the cutters, which has just been treated.

He meant it too. Any luckless student, including yours truly, who was careless enough to add the unwanted "x" would be brought sharply to his senses in no uncertain manner. He was an extremely accurate shot with a piece of chalk and would send a missile whistling past one's ear with only fractions of an inch to spare. He never hit anyone (as far as I can remember) but the near miss, accompanied by the resounding crack as the chalk hit the wall behind, was enough to bring one back to earth in short order.

But to return to the printed circuits. The next section of the pamphlet deals with: "Circuit Tracing and Voltage Measurement."

"Circuit tracing of the printed wiring board is simpler than that of the conventional wiring due to the uniform layout. Since the board is translucent, a 60 watt light bulb placed underneath the side being traced will facilitate location of connections. Test points can easily be located in this manner without the necessity of viewing both sides of the board.

RESISTANCE MEASUREMENTS

"Resistance or continuity measurements of coils, resistors, and some capacitors, can be made from the component side of the board. In some cases a magnifying glass will assist in locating very small breaks in the wiring. Voltage measurements can be made on either side of the board, a needle point probe for circuit checking should be used.

"Different methods of mounting valve sockets are used on printed wiring boards. Remember to count the pins anti-clockwise when viewing the top of the socket and clockwise when viewing the bottom of the socket. Note: The key to most sockets mounted on the component side of the board can be located from the wiring side by the absence of a lug hole in the board at the key position."

An interesting point in the above bar is the reference to "very small breaks in the wiring". These appear to be one of the hazards peculiar to printed circuits and are known as "hairline cracks". As the name suggests, they are very fine, often no more than a "thou." in width, and thus difficult to detect with the naked eye.

They are apparently due to the copper foil lifting during the dip-soldering process and possibly rupturing due to lack of support. In most cases the solder itself will bridge the gap, making a perfect conductor in spite of the defect. In fact, the presence of the defect need never be known.

Occasionally, however, the solder fails to bridge the gap, leaving a fine break in the wiring which may cause trouble either immediately or at some future date.

It is only fair to point out that such defects are extremely rare. At the worst they would appear to occur once in several hundred boards, while other authorities claim the probability to be nearer once in several thousand.

But from the serviceman's point of view, the important thing is to know that they can occur and how to look for them. A moderately powerful magnifying glass is one method of attack, while simple continuity checks along the suspected conductors is the obvious one. In practice it would appear that the two methods are complementary.

Now we come to the real meat of the article: "Replacing Components".

"Defective resistors, ceramic disc and paper capacitors can be replaced by one of the following three methods without removing the printed circuit board from the chassis.

"METHOD 1. If the leads extending from the defective component are long enough for a replacement component to be soldered to them, cut the leads where they enter the defective component. See figure 1.

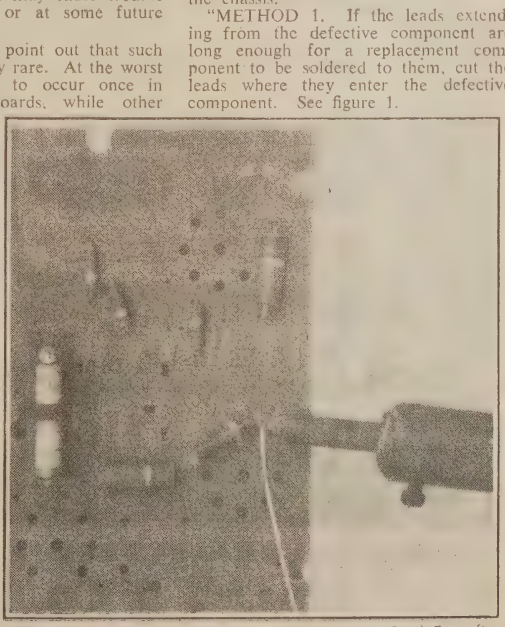

Figure 4. Loop the pigtails of the new component around the salvaged leads and solder in place. Use no more heat than necessary to make a satisfactory joint. It is recommended that the leads of the new component be carefully cleaned and tinned before fitting.

"Q-PLUS"

"Q-PLUS" T.V. I.F. STRIP

NO TEST EQUIPMENT NECESSARY

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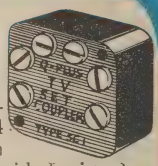

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These come individually or as a kit, but in kit form full instructions and circuit are included.
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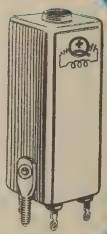

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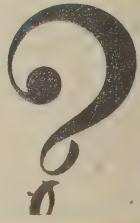

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"METHOD 2. If the leads extend- g from the defective component are OT long enough to use method (1), t the defective component in half. ien cut through each half of the mponent until it is broken away from lead. By doing this carefully, enough tra lead (from inside the component) ill be gained to permit soldering the placement component to it. See fig- es 2 and 3.

"Clean off the ends of the remaining ads, leaving as much lead as pos- ble. Make a small loop in each lead the replacement component and slide e loops over the remaining leads of e old component. See figure 4.

"Caution should be taken not to erheat the connection since the copper il may peel or the original component ad may fall out of the board. This possible due to heat transfer through e leads. The lead length of the re- acement part should be kept reason- ly short to provide mechanical rigid- ."

EST METHOD

These two methods assume that the mponents have already been tested id proved faulty beyond doubt. As we know, this is not always possible ithout being able to lift one end of e component to isolate it from paral- l circuits. When this has to be done e third method is recommended. It as follows:

"(a) Heat the connection on the wiring de of the board with a small soldering on. When the solder melts, brush it way with the wire brush. Do not erheat the connection. Do not leave e iron on the connection while brush- g away the solder. Melt the solder, move the iron, and quickly brush way the solder. It may require more an one heating and brushing process remove the solder completely.

"(b) Insert a knife blade between e wiring foil and the bent-over com- ponent lead and bend the lead perpen- icular to the board. (It may be neces- ry to apply the soldering iron to the nnection while performing this step it is sometimes difficult to completely eak the connection by brushing.) Once gain, do not overheat.

"(c) While applying the soldering iron the connections, 'wiggle' the com- ponent until it is removed.

"(d) Remove any small particles of lder using a clean cloth dipped in lvent.

"(e) A thin film of solder may remain er the hole through the board after moving the component. Pierce the m with the lead from the new com- ponent after heating the solder film ith the soldering iron.

"(f) Insert the leads of the new com- ponent through the holes provided. Cut desired length and bend over the ds against the copper foil. Resolder e connections with 60/40 low temper- ure solder."

The wire brush mentioned in the bove pars appears to be of fine bronze ire, which is used in a number of dustrial processes. In any case it ould be available from the Admiral o., along with other items for the pair of printed circuits.

Regarding the actual technique, it ould seem that brief applications of eat, each achieving a certain amount of progress, and each followed by a cooling period, is the safest method. In this way definite progress can be made, without raising the temperature of the base material to a dangerous degree. To hasten the cooling and thus speed up the job, I would once again suggest dousing the joint with methylated spirit.

COMPLEX COMPONENTS

The next point to be considered is the handling of more complex components having more than two connections and using lugs rather than pigtails. These include IF and ratio transformers, valve sockets, etc., and may call for more care due to the increased number of anchor points.

"REPLACING IF TRANSFORMERS, etc. There may be seven soldered lugs on a ratio detector and up to six on an IF transformer. Replacing these components requires more time and patience than required for other components. The following procedure is recommended:

"(1) Apply the soldering iron to one of the connecting lugs and brush away the melted solder. On some transformers it will be necessary to bend the mounting lugs perpendicular to the board while the solder is molten, so as to be able to brush away the solder.

"(2) Cut off the transformer lug as close to the board as possible. Repeat step (1) for each lug. Use a cloth dipped in solvent to remove any specks of solder stuck to the board.

"(3) Insert the replacement transformer and solder the connections. NOTE: No special precautions are necessary when mounting the new transformer. It is not necessary to twist the transformer mounting lugs of the new transformer before soldering."

NOT A TRAGEDY

All of which seems pretty straightforward, if, perhaps, a little tedious. Doubtless a little practice will remove most of the terrors, particularly when one remembers that even if the worst happens and a section of foil is damaged, it is not a tragedy. Although not quite so neat, the set will work just as well if a piece of wire is substituted.

In the case of valve sockets the Admiral pamphlet suggests, first, that minor defects can be more easily cured by working on the socket itself than by replacing it. This applies particularly to intermittent contacts, due to loss of pressure, dirty contacts, etc.

For more serious defects, or versions of the above which will not respond to

(Continued on Page 123)

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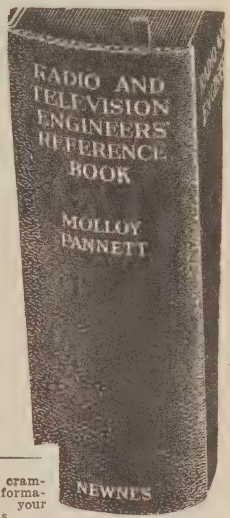

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RTRB14

purchased with barrene. It is really i tended for perspex, but works equal well with barrene. (We obtained o supply of barrene from Bingham Bro of Booth St., Annandale, NSW, but va ous other firms supply barrene or pe pex.)

Very few tools are required for wor ng with plastics, no more than are like o be available these days to the avera handyman.

Much of the work can be done wi he aid of a hacksaw and a medium a ine grade of sandpaper. A power sand and buff will simplify the job conside bly.

Extreme care must be taken not mark the surface of the plastic by ove zealous use of coarse sandpaper. De scratches are very difficult to remove

Absolute cleanliness is essential making a good joint between plastic su faces. If any dirt is present, it will cemented in, giving it a bad appearanc Cement should be applied to the joi only, and should not be allowed to co act adjoining material, as it will spo he surface.

SPEED ESSENTIAL

Speed is essential also in making a goo oint, as the cement dries very quickl All joints should be prepared and th material ready to hand before the ceme is applied. Use of jigs, consisting of wo blocks and G-clamps, speeds up the pr ess considerably.

For an initial effort, it is wise to u the least possible number of bends. T make a good bend, a certain amount practice is essential and, in the proce

LITTLE GENERAL IN PLASTIC

Here is a project readers have been asking for—a plastic cabinet for the "Little General" and for good measure one for the "Personal Power Supply" featured last month. Don't let the idea of working with plastics scare you off, it's really quite simple, more so in fact than working with plywood and leatherette. Convinced? Well let's give it a go.

PLASTICS have been available to hobbyists for a number of years, yet few have explored the potentialities of this workable medium.

Plastic materials are not particularly cheap, but everyone must agree that they are extremely attractive, durable and last but not least—they do not harbor dust.

This last feature alone, is reason enough for the use of plastic as a medium in cabinet design.

TYPES OF PLASTIC

A number of materials are collectively termed "plastics". The term means anything possessing plasticity, anything which can be moulded by mechanical stress, without losing its cohesion, yet able to retain the new form given it.

There are two types of plastics in general use today, described as "thermo-setting" and "thermo-plastic".

The former, of which bakelite is an example, do not interest us. The latter, into which group fall materials such as perspex, polystyrene and barrene, are readily moulded into any desirable shape by the application of heat.

We selected barrene, a high impact polystyrene, which is relatively cheap and in good supply, being locally produced.

Barrene is readily available in sheet form. The color range is not very great, but it should be sufficient to meet most requirements.

A suitable cement, that goes by the name of ethylene dichloride, may be

by Wes Yashin

of experimenting, some of the materi could be spoiled.

Using the same method of constructi as for plywood, there is less likeliho of spoiling material. The plastic "Lit General" cabinet as illustrated was bu this way and we suggest you do the sam

DETAILED DRAWING

We have prepared a detailed drawi of the required dimensions. These dif from the dimensions given for the p wood cabinet in an earlier issue, by t difference in the thickness of the mat ials used.

Another point is that the height of t front panel has been increased to all the curved top portion to be fitted insi the front and rear panels.

The total quantity of ⅛-inch Barre required is approximately 256 squa inches, allowing for some waste to used as slats and for scraps to be d solved as a filling compound. Ho

ver, the exact quantity will vary ac-
ording to its shape and the way the
arious pieces can be cut from it.

The first job then, in building the
abinet, is to plan how the various
ieces are to be cut from the sheet and
mark it out accordingly.

If you can manage to have the pieces
t to size by the suppliers, so much
e better, as their edges will be straight
id square.

If working from a whole sheet, due
lowance must be made for saw-cuts
id a sixteenth of an inch or less for
ling or sanding. Make sure that every-
ing is squared properly. Use your
quare and double-check prior to cut
ng.

To mark out the curved portions rep-
senting the tops of the front and rear
anels, set up a pair of compasses to
ve a 12-inch radius, then locate the
ntre on a line passing through the
iddle of the panel. Scribe an arc on
e panel, placing it so as to give the
rrect height at the side of the cabinet

If a pair of compasses is not avail-
ble, a length of string and a pencil will
ake a good substitute. A coping saw
ill be required to cut out the radiused
rtions.

When cutting, frequent lubrication
ith water is desirable. As an alterna-
ve, cut with slow and steady strokes
ing the full length of the blade. If
e above are not observed, frequent
mming of the blade will occur, due to
e plastic becoming overheated and fus-
g.

MAKING A JIG

The next step prior to assembly, is to
t a few scraps of wood, sufficient to
rm a jig. A piece of board or ply-
ood, of sufficient length and width, is
ed as a base. The bottom portion of
e cabinet is placed centrally on and
amped securely to the base by means
a 3in x 2in block and a G-clamp.

Next, the cabinet side pieces are fitted
mporarily to the bottom piece and
ld in place by means of 3" x 2"
ocks, nailed to the base on either side.
emove the side pieces and apply
ment to the inside ends that come in
ntact with the adjacent ends of the
ttom piece.

Reinsert the end pieces, by a to and
o motion in order to force any air out
d form a good joint. Make doubly
re that all the edges are in perfect
ignment, as this will decide whether a
od joint may be formed when fitting
e front of the cabinet.

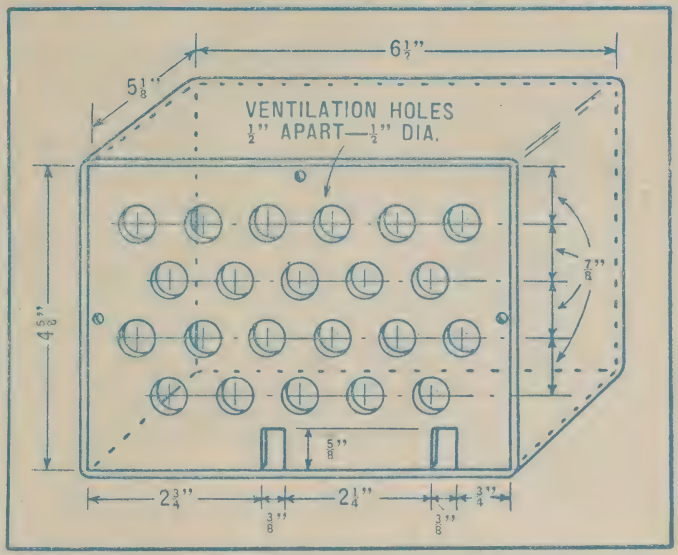
The work should then be left to dry
r at least two hours. As ethylene di-
loride is a solvent, it fuses the two
rfaces and, if allowed to dry for the
escribed length of time, the joint
rmed should be as strong as any sec
on of the whole material.

FILLING AND SANDING

When the work is dry proceed to file
sand the top of each end piece, to
ke the curved top piece. A very close
timation of final angle may be obtain-
d by temporarily fitting the front and
arking the angle from the radius al-
ady marked thereon. This should be
creased by the thickness of the top
ece.

Before proceeding any further with the
sembly, it would be wise to take time
to enlarge the jig for the next step.

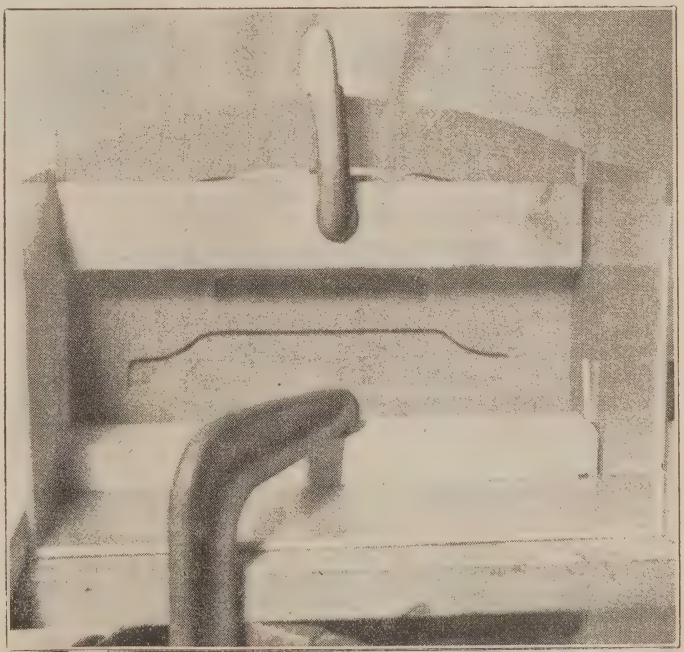
POWER SUPPLY CABINET DIAGRAM



Essential details of a cabinet for the Portable Set Power Supply described in last month's issue. The inside dimensions are given.

Further additions to the jig consist of cutting two 3" x 2" blocks, the length of which should be the inside width of the cabinet.

A piece of board or plywood is then cut and radiused to conform with the front piece. The reasons for the radius is that it may later on be used



A view showing the jig in use while cementing the sides and front of the cabinet. A section of the right-angled portion, referred to in the text, is visible through the fretwork. Matchsticks are used as wedges to keep the side level.

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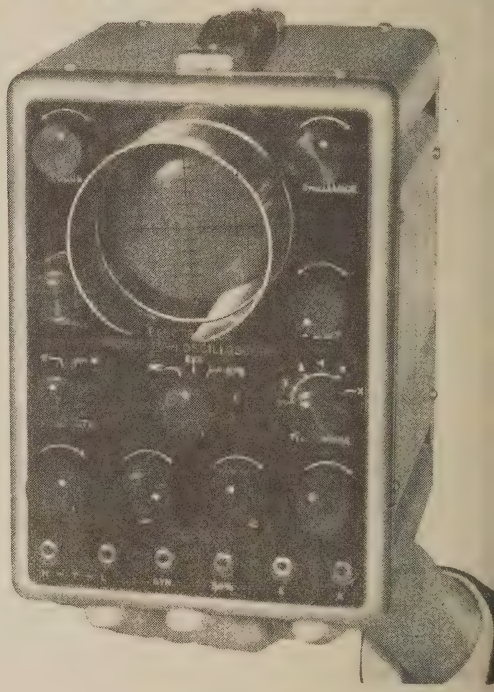
ELECTRONICS

MODEL TV-1 OSCILLOSCOPE



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Specifications –

Vertical Amplifier: 2 position switch for choice of gain/bandwidth conditions. Push-pull amplifier gives a symmetrical undistorted picture.

"N" position . . .

sensitivity 50 mV/Cm. D.C. to 100 Kc/S. (—3db).

"W" position . . .

sensitivity 500 mV/Cm. 20 c/s to 3Mc/S. (—6db).

Deflection is not limited in the "N" position and the undistorted amplitude may be expanded to more than fill the screen. In the "W" position, the undistorted amplitude is limited to a height of 2 Cm (¾") which is quite adequate for the examination of television pulses.

In addition to a gain control, alternative input sockets are provided, the "H" position utilising the total amplifier gain, with a D.C. input resistance of 0.5 megohms.

The "L" (low) gain position provides an attenuation of 20 times with a D.C. input resistance of 10 megohms and is frequency compensated.

Horizontal Amplifier: D.C. to 100 Kc/S. (—3db) with a maximum sensitivity of 70 mV/Cm and an input impedance of 1 megohm. A continuously variable gain control is fitted.

Time Base: In five ranges with continuously variable control provides sweep of from 5 c/s to 50 Kc/S. The time base is fed through the horizontal amplifier, so giving symmetrical deflection from zero to 5 screen diameters. Fly back is suppressed.

Synchronisation: Manual amplitude control.

Miscellaneous: All deflection plates and grid of C.R.T. are available for direct connection at the rear of the instrument. Direct coupled shift controls give instant spot shift.

Power Supply: The instrument is mains operated from 200–250 V. a.c. 50 c/s.

Power Consumption: Approximately 30 watts.

Dimensions: 6½" × 9" × 8".

Weight: 6½ lb. approximately.

Current Price: £57 10s. 0d., plus Sales Tax.

Ring, write or call

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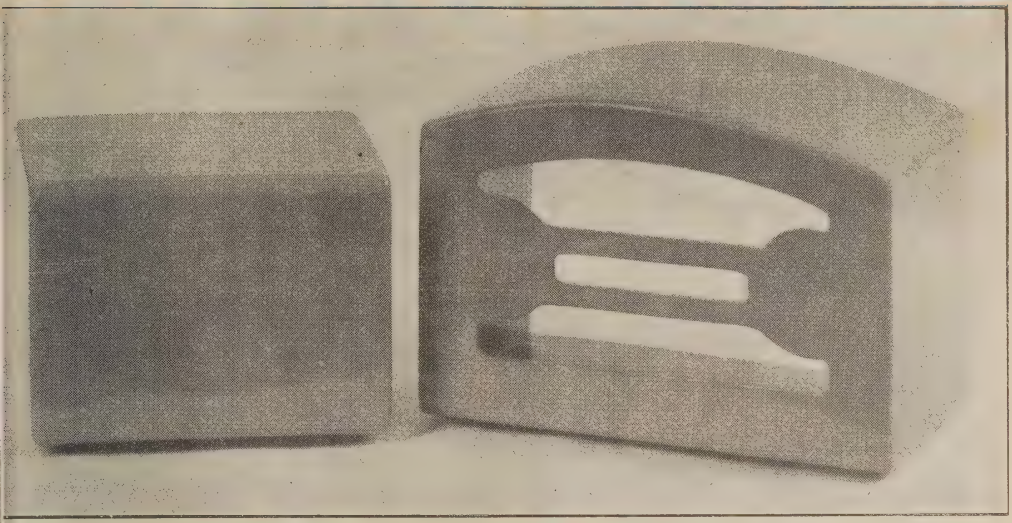
309

CABINETS FOR LITTLE GENERAL & POWER SUPPLY



A view illustrating the general attractiveness of the finished cabinets. The fitting of dial scales, knobs and extruded aluminium behind the fretwork, should greatly enchance the appearance.

a guide for shaping the curved top of e cabinet. Nail one of the blocks to e lower end of the radiused board, ereby forming a right-angled jig to ld the front panel securely in place ile drying.

The remaining block is used as a eader to ensure that the tops of the e pieces are equidistantly spaced apart. The speaker fret may now be cut out, er which the front panel is cemented place. Use is made of the jig pre-)usly constructed, to keep the front urely in place while drying.

Barrene has a tendency to warp and may be found necessary to use pieces matchstick as wedges, to ensure per-t contact over the whole surface.

The rear radiused portion may be nented at the same time as the front. jig to keep this secure would only mplicate matters, and it should be ficient to weigh it down while drying.

When the work so far assembled is y, the top piece of the cabinet may shaped, using the radiused jig as a igh guide.

We have found that an electric radia- is the best source of heat for bend- plastic sheet. Regulation of heat is y simply achieved by altering the tance of the work from the radiator. oreover sections at a time may be ex-sed to heat while the rest of the mat-al is covered.

Readers who do not possess a radiator y use a cooking oven, but care must taken not to overheat the work, as it y warp and blister. The makers of rrene do not suggest the use of hot ter as a softening medium, as a higher nperature is necessary to make the terial pliable.

SING THE RADIATOR

When using a radiator, hold the work out two inches away from the front lle. There is no point in trying to t the material quickly by working closer, as this will blister the surface.

Do not try to shape the curve in one or two bending operations. It is better to do this gradually, by constantly re-heating sections of the work. An important point when heating is to keep and exposed sheet free from dust and other particles, as these may become embedded in the softened surface.

Having obtained a satisfactory curve, proceed to cement the top piece into place. Keeping in mind that the top piece is not cemented over the top of the front and rear partitions, but on the inside.

The reason for doing so is, that it is very much easier to cut a straight line level, than it is a curved one.

Also, if the pieces are purchased individually cut to the right dimensions, the straight edges should be perfectly true, whereas the curved portions will have to be cut with a coping saw, and trued up with a file.

To keep the top piece in place while drying, the work should be laid face down on the base, with the top of the cabinet against the right-angled portion of the jig.

A wedge is used to apply sufficient pressure on the curved portion to ensure a good contact of the edges. A weight is then placed over the rear of the cabinet and the work left to dry.

MAKING PUTTY

If some of the joints require building up, a suitable putty may be made by dissolving scraps of Barrene in the cement.

Use this putty sparingly as removing the excess will involve extra sanding, which is not desirable.

Before commencing the final sanding and polishing, the work should be left to dry for several days, if this can be managed. The ideal drying place should have plenty of circulating air.

To bring the joints and built areas to a satisfactory level, use a fine grade of sandpaper. The use of a power sander is to be recommended. Do not allow the sandpaper or sanding disc to rub on the one spot for any length of time, as this will fuse the plastic.

Rather let the sander travel over the work forwards and backwards in a sweeping motion.

The various joints may be radiused slightly, but don't be tempted to overdo it as this will weaken the joints.

When all the edges have been filed down to a satisfactory level, proceed to smooth these with a very fine grade of sandpaper. Only the areas close to the joint should be sanded. Avoid, if possible, marking the adjacent surface, as scratch marks are very difficult to polish out.

POLISHING

Polishing of the sanded portions should be broken up into two operations. The first may be done with a wad of damp cotton wool dipped in pumice powder, the final with liquid metal polish.

Before applying the metal polish, wash the surfaces to be polished to remove any pumice powder left from the previous operation.

Readers who have access to a power buff will find the last operation considerably simplified. Application of buffing soap to the buff should ensure the original glass-like finish of the Barrene.

It now remains to fit a pair of slats as feet to the bottom of the cabinet and it will be ready for use. The slats are made up of two thicknesses of Barrene, 4½ inches long by 3-8-inch wide, cemen-

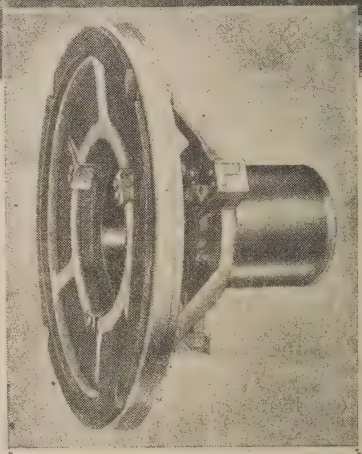
(Continued on page 55)

Axiom 80

This hand-built full range loudspeaker, originally designed as a monitor loudspeaker for professional applications, is now available for use in High Fidelity equipment.

A unique constructional feature is the use of two triple sets of paired double acting cantilevers which provide a suspension with very low axial stiffness. Twin diaphragms are employed to cover a frequency range of 20 c/s to 20,000 c/s with outstanding smoothness. Maximum power handling capacity 6 watts; which may be increased by two or four units.

Cabinet designs available for one, two or four Axiom 80 Loudspeakers.



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● *Post the coupon now for colour brochure describing the Axiom 80, and details of other loudspeaker units in Goodmans High Fidelity Range.*

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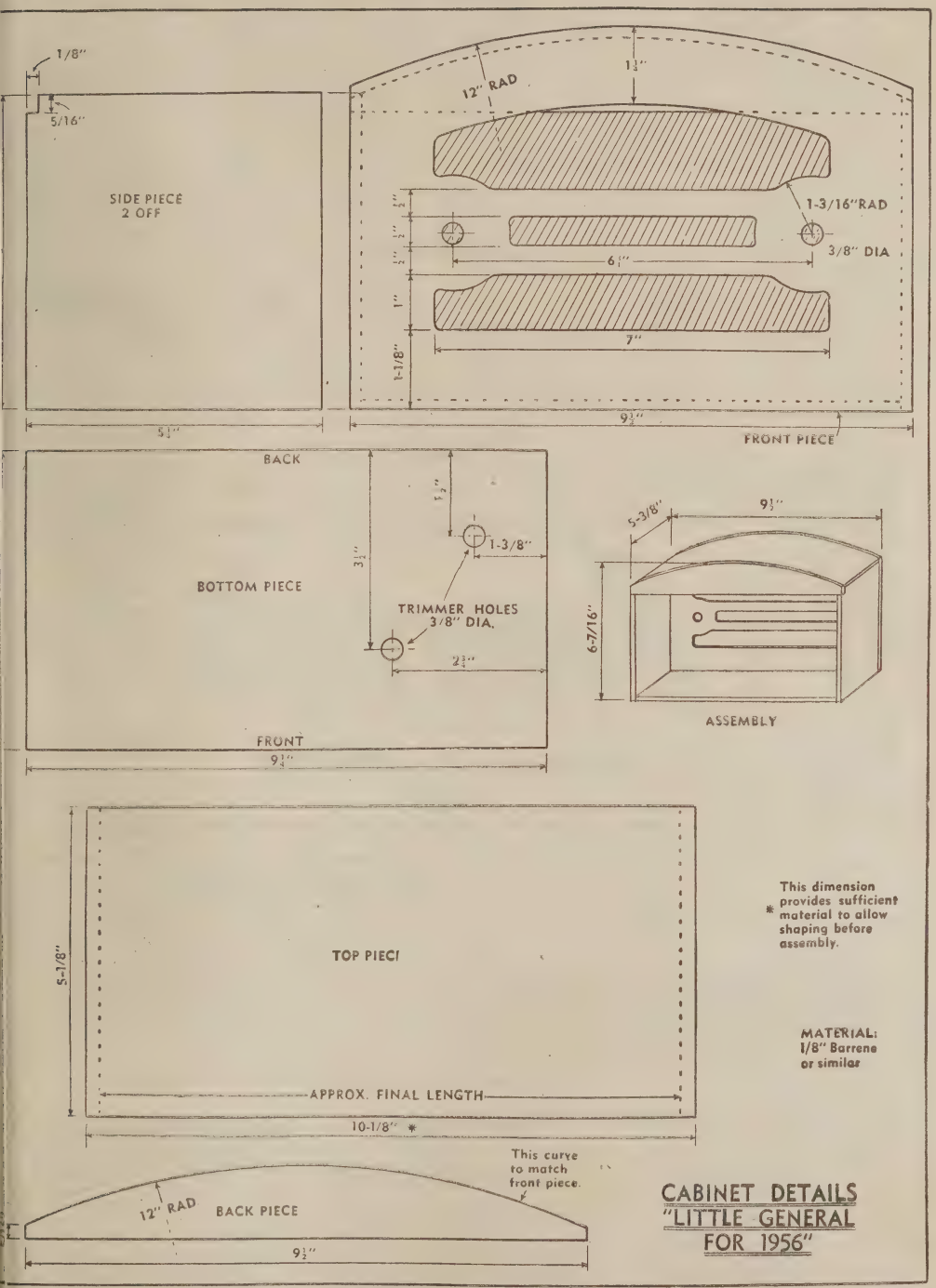
DETAILS OF LITTLE GENERAL CABINET



CABINET DETAILS "LITTLE GENERAL FOR 1956"

These plans will help you mark out the material for your plastic cabinet. They are equally useful if you decided to make a cabinet from wood.

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Wire Wound Pots. 1000, 2500 and 10,000 ohms **3/11 ea.**
Speaker Windings **20/- doz.**
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5 x 3	8/-
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11 x 8	17/6
13 x 7	17/6
13 x 10	21/9
17 x 8	27/-
17 x 10	36/-
17 x 12	32/7

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⅝in	26/8
¾in	35/2
1in	52/5
1 3/16in	57/9

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Ditto with lift-up lid.
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Mantel Chassis 4 Valve	8½in x 5½in x 2¼in	8/11
Mantel Chassis 5 Valve	12in x 6in x 1¾in	9/11

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Various Makes — while they last .. .. **16 Gns.**

CARRYING CASES — suit above changers — attractive leatherette cabinets **£7/15/-**

together. For a neat appearance
r these slats so that the standing
ace is ¼-inch wide. Each end is then
nded off accordingly.
word about fitting the dial trans-
may not be out of place. The sim-
t way is to transfer these directly
to the cabinet and when perfectly
to coat them with clear lacquer.
his way the protective celluloid discs
not required.
n alternative methods is to slide the
sfers on to the celluloid discs and
ch the completed transfer to the
inet by means of countersunk bolts.

WER SUPPLY CABINET

o much for the Little General cabi-
and now a word about the cabinet
the Personal Power Supply.
he constructional points discussed in
earlier paragraphs apply as well to
cabinet for the Personal Power Sup-

he total quantity of material required
be approximately 203 square inches
a sketch with suitable dimensions is
oduced.
s an experiment, we shaped the top,
t and bottom of the cabinet from
piece, so that only the sides had to
emented in, allowing for a minimum
oints.
owever, we have found that the
hod of construction used for the
e General cabinet is the better one.
for the benefit of those who wish
experiment with the shaping of
cabinet by the application of heat.
are details of the method that we
ated.

The work to be bent is sandwiched between two pieces of plywood. Heat is applied to the bend area only. The material must be made sufficiently plastic to bend under its own weight. Care must be taken not to stretch the work as the edges immediately after the joint will then be out of true. Moreover, corrugations may form on the surface of the material.

If the bend is made while the work is insufficiently plastic, internal stresses give rise to multiple fine cracks that become visible when the material has cooled off.

A rear panel and a pair of slats, for feet, will provide the finishing touches to this cabinet. The panel is anchored to three blocks cemented to the inside walls of the cabinet. These blocks are drilled and tapped to take 1-8-inch bolts which pass through corresponding holes in the panel.

VENTILATION

The blocks need not be more than ¼-inch square and two thicknesses of Barrene deep.

A number of ½-inch holes will have to be drilled or cut in the rear panel so as not to impair ventilation. We provided four rows of ½-inch holes, equidistantly spaced. Two slots are cut in the lower end for the incoming and outgoing cables.

Well, there they are, quite straightforward and should not present any major problems. If the various points discussed in the text are adhered to, the finished articles should compare favorably with commercial cabinets.

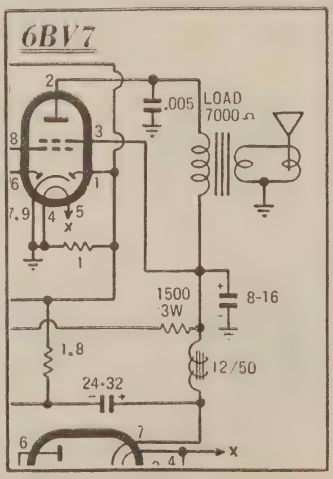
ADDING A FILTER CHOKE TO THE LITTLE GENERAL

Here is the promised article on how to fit a filter choke to the 1956 Little General. It will remove any residual hum resulting from the simple resistance filter used so far.

HETHER this is absolutely essen-
tial depends in a large degree on
umstances. For ordinary listening
ditions, where the listener is norm-
several feet from the receiver and
volume is set to a moderate level,
existing filter should be perfectly
quate.
'um is only likely to become a prob-
under low-level conditions; bedside
ration being a typical case. Here it
sual for the speaker to be quite close
he listener's ear and the volume to
reduced by a proportional amount.
owever, reducing the volume does
reduce the hum level by the same
r, since most of the hum is intro-
d "after" the volume control. As
sult, the hum level appears louder,
tive to the signal. So, if you en-
nter this kind of problem we sug-
you fit the filter choke. If not,
e it as it is.

he choke required is one having an
ictance of about 12 henries and rated
0 mA, such as the Rola 12/50. The
rical characteristics are not particu-
critical, but the physical size is,
s being just enough room to accom-
ate this type.

you are considering a substitute the
wing dimensions should be check-
Mounting centres, 2 1-8in. Height,
. Width 1 5/16in. This last dimen-
is most important, there being just



The choke is fitted between the 1st and 2nd electrolytics. The 3500 ohm resistor is retained to preserve correct voltages to the earlier stages.

enough room without awkward crowding.

The choke is mounted between the speaker transformer and the oscillator

(Continued on Page 123)

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Treble Speaker, Wharfedale Super 8CS/AL. An outstanding treble unit with aluminium and response up to 20,000 CPS Price of two units £52/16/3

BAKER 12in DE LUXE

Cloth suspend cone for natural bass and aluminium dome for extended treble response. Cone resonance 35 cps. Price ... £27/13/3

GOODMANS AXIOM 150 Mk II 12in

A twin cone speaker with a response 30-15,000 cps with a power handling capacity of 15 watts. Price ... £26/8/3

WHARFEDALE 10in/CSB

After the 12/CS/AL the 10in/CSB is the best single speakers in the Wharfedale range. Price ... £25/5/6

MSP JENSEN COAXIAL

A 12in woofer with a 2½in coaxial mounted tweeter. VC impedance 12 ohms. Price £17/12/6

PEERLESS COAXIAL 12in

With 5in tweeter coaxially mounted provides an exceptionally smooth response. VC impedance 15 or 3.2 ohms. Price ... £16/17/6

STENTORIAN HF 1012 10in

This amazing speaker is now available from stock. Cone resonance 35 cps, VC impedance 15 or 3.7 ohms. Price ... £10/0/0

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A horn type tweeter, ideal for conversion twin system. Price of any single speaker to £12/12/6

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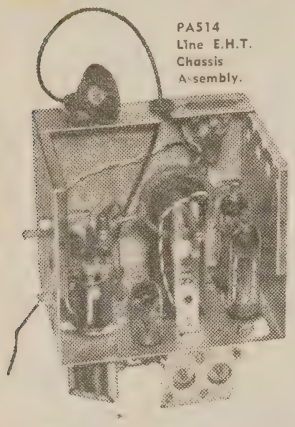
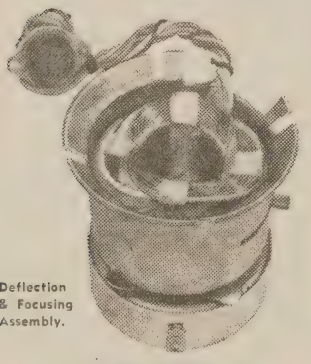
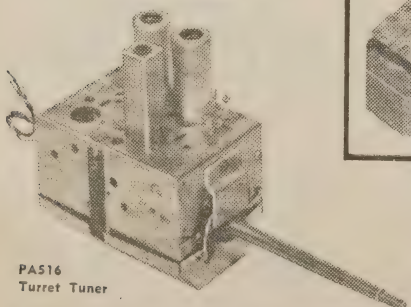


PA514
Line E.H.T.
Chassis
Assembly.

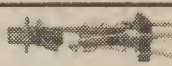


Deflection
& Focusing
Assembly.



PA516
Turret Tuner

L146 Coupling Coil Yellow.



L147 Video I.F. Coupling & Trap Coil Green.

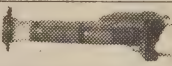
L148 Coupling Coil Blue

L149 Coupling Coil Violet

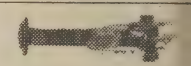
L150 Video I.F. Sound Trap Coil Orange.

L151 2nd Video I.F. Transformer Red.

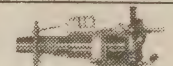
L152 1st Video I.F. Transformer Brown.



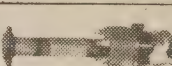
L187 1st 5.5. MC/S I.F. Trans. White.



L188 5.5. MC/S I.F. Transformer Black



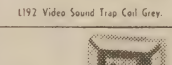
L189 F.M. Ratio Detector Transformer



L192 Video Sound Trap Coil Grey.

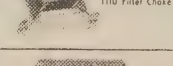
T129
Line Linearity
Coil.

T110 Filter Choke

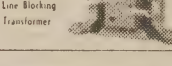


T125
Line Blocking
Transformer

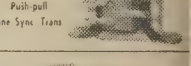
T126
Push-pull
Line Sync. Trans



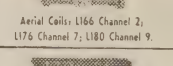
Aerial Coils: L166 Channel 2;
L176 Channel 7; L180 Channel 9.



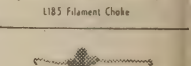
Filament Chokes;
L154 Green; L155 Yellow; L156 Red.



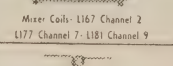
L185 Filament Choke



Mixer Coils: L167 Channel 2
L177 Channel 7; L181 Channel 9

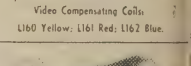


Video Compensating Coils:
L160 Yellow; L161 Red; L162 Blue.

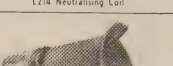


L214 Neutralising Coil

T115
Frame Output
Transformer



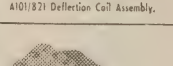
Trimmer Condensers, C118, C212.



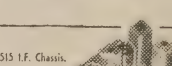
A101/821 Deflection Coil Assembly.

T117 Deflection Coil

T116
Horizontal Output Transformer



T112
Power Transformer



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PART FIFTEEN—THE FM SOUND CHANNEL

Before following the picture signal through the video system to the picture tube, it is logical to digress briefly in order to examine the operation of the intercarrier IF sound channel and, in particular, the FM sound detector into which it feeds.

THE difference between the "split-sound" and the intercarrier principle was explained in part 13 of this present series.

Briefly, in a "split-sound" receiver, the IF resultant frequency of 30.5Mc would be diverted from the plate circuit of the frequency changer or an early IF amplifier stage, and passed through an entirely separate IF channel centred on this frequency.

The design of such a channel follows closely the practice in a conventional AM sound receiver, except that the channel frequency is lower in the latter case (10.7Mc) and the deviation somewhat wider (plus and minus 75Kc). In other respects, circuit practice is similar.

IF STAGES

From two to four IF amplifier stages may be used, one or more of them operating also as limiter stages, to reduce sensitivity of the system to AM pulses of one kind or another.

The coupling circuits must be designed to give a bandpass effect so that the incoming frequency modulated signal can reach the discriminator transformer without prior restriction.

Usual practice, as in FM receivers, is to use double-tuned transformers, with resistance loading to reduce the winding "Q", or discreetly overcoupled to give an overall flat-topped effect.

In practice, the split-sound principle has been almost completely discarded, partly on the grounds of complexity and partly because it leads to difficulties with tuning and tuning drift.

There is no great point, therefore, in discussing it further.

The alternative "intercarrier" principle involves extracting from the video detector the incidental heterodyne which occurs between the sound IF resultant (30.5Mc) and the picture IF resultant (36Mc). This heterodyne beat of 5.5Mc contains both picture and sound modulation.

It is passed into a supplementary IF channel, tuned to 5.5Mc and thence to an FM detector of one type or another. The amplitude picture modulation is removed in the process and the FM sound content resolved for application to the audio amplifier.

Since the 5.5Mc beat is dependent only on the incoming carrier frequencies, it is not affected by oscillator drift in the receiver. It is claimed, overseas, that the receiver tuning can drift by up to 0.5Mc before programme quality is unduly affected. In a split-sound receiver, a mere fraction of this drift would be sufficient to produce distortion of the FM sound channel.

Because the intercarrier beat emerges from the video detector at relatively high level, not a great deal of further amplification is necessary before it is applied to the FM detector.

In the simplest case, it is possible to pass the signal through a single amplifier stage at 5.5Mc, thence to a ratio detector, which is capable of substantially rejecting the AM component and resolving the FM sound component.

Figure 92 shows the circuit of just such a system, extracted from a prefabricated and prealigned Video and Sound IF strip, manufactured locally by Messrs. R. W. Steane and Co., Pty., Ltd. (Q-plus). This involves a 6AU6 amplifier, feeding a 6AL5 as a ratio detector.

The simplicity of the circuit is obvious when contrasted with a complete sound IF channel, as required by a split-sound receiver.

The alignment instructions for the sound channel in this particular unit, are likewise simple. We quote:

"INTERCARRIER SOUND: Connect AM signal generator at 5.5Mc (mod. 30 pc) to junction of c C11 and video detector plate; tune VIF7 maximum. Tune VIF8 primary to maximum output, secondary to minimum. The alignment of defector can be checked with a sweep oscillator, plus CRO, if desired."

Alignment instructions for commercial receiver sound channels are often more complicated than this and should be followed in detail along with the rest of the alignment procedure.

As previously mentioned, a precision oscillator, preferably crystal controlled, is necessary to centre the sound channel of 5.5Mc. Alignment to the wrong centre frequency will produce distortion on sound amplitude peaks, which will not be properly corrected by manipulation of the tuning controls.

FOR LOW SIGNALS

The implication from the manufacturer's data is that the performance of a sound channel using this simple system (fig. 92) is adequate in all favorable signal areas.

However, where the signal strength is low or where electrical interference is likely to be a particular problem, provision is made to add one stage and to change the circuit constants to provide

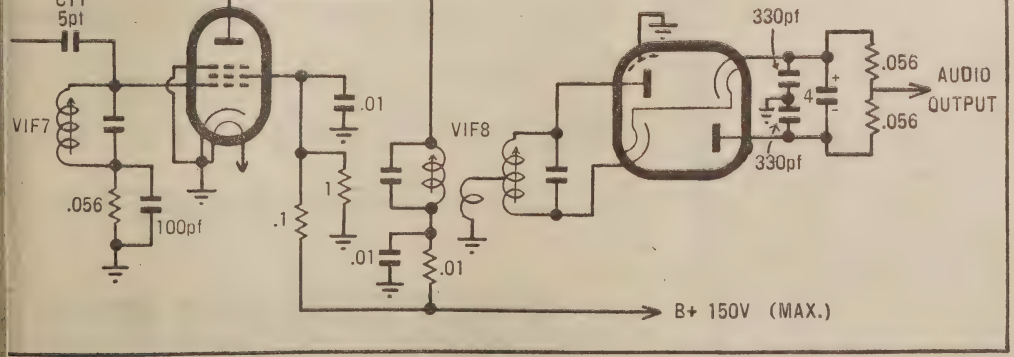

Figure 92: Circuit details of the intercarrier sound channel, taken from the "Q-Plus" prefabricated IF channel. For use in poor signal areas, or where interference is a problem, a limiting stage may be added.

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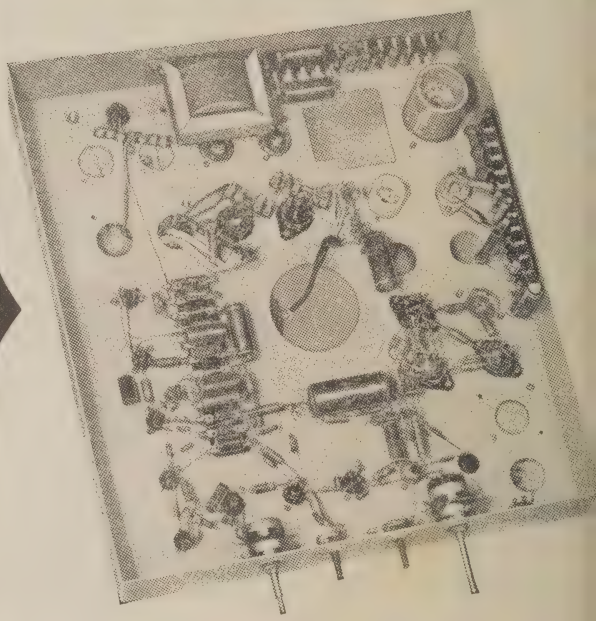

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better amplitude limiting effect ahead f the ratio detector.

The sound channel is thereby render- d much more proof against ignition r other electrical interference, and, in act, against inadvertent amplitude in- erference from its own or an adjacent icture' signal.

The use of one amplifier stage, fol- owed by a limiter and then a ratio etector is typical of common prac- ice in commercial receivers.

A limiting amplifier looks much the ame as an IF amplifier stage, and, in act, it is one. However, the operating onditions are adjusted so that it func- ions normally in an overloaded condi- ion—just the reverse to AM practice.

IMITER STAGES

Limiter stages are always located just head of the FM detector, where a large nput signal is available. Since the valve perates with low bias, low plate and ow screen voltage, it has no chance of ealing adequately with the signal fed o it.

In an AM receiver such a condition ould lead to intolerable distortion. The arying amplitude of the signal contains he modulation, and the shape of the nodulation envelope must be preserved t all costs.

In the case of an FM signal, the sig- ificant feature is the frequency varia- on and the amplitude can be subject to evere limitation without danger of reating distortion.

Figure 93 shows the circuit of a typ- cal limiter stage using, normally, a harp cut-off RF pentode.

No initial bias is provided. However, he grid is driven positive on incoming ignal peaks and the resulting grid cur- ent flow sets up a proportional negative oltage across the grid return resistor and ypass.

Grid bias is thus determined by the average" amplitude of the incoming ignal.

The time-constant of the grid return esistor and bypass has a bearing on the recise action of the limiter and may be aried considerably according to the deas of the designer.

It will be noted, also, that the plate oltage is applied through a large drop- ing resistor, suitably bypassed, while the creen voltage is also kept quite low, in his case by means of a voltage-divider etwork.

Because of the restricted operating onditions, the stage tends to clip the eaks of all high-amplitude input signals.

OUBLE LIMITATION

Positive-going peaks suffer a double mitation. Because grid current flows uring these peaks, the stage input im- edance is sharply reduced and the peak mplitude is likely to be reduced along ith it. However, the residual positive ulse which is effective on the grid can- ot produce more than a limited rise in late current, because of the low plate nd screen voltage.

Negative-going pulses, on the other and, simply run the valve beyond plate urrent cut-off, again because of the everely restricted operating conditions.

Figure 94 illustrates these points graph- ally, though only in respect to the late current curve. It is apparent that he plate current cannot operate beyond he limits of cut-off on the one hand and aturation on the other.

Provided that the input signal is always fficient to drive the valve beyond these mits, its output will be reasonably free

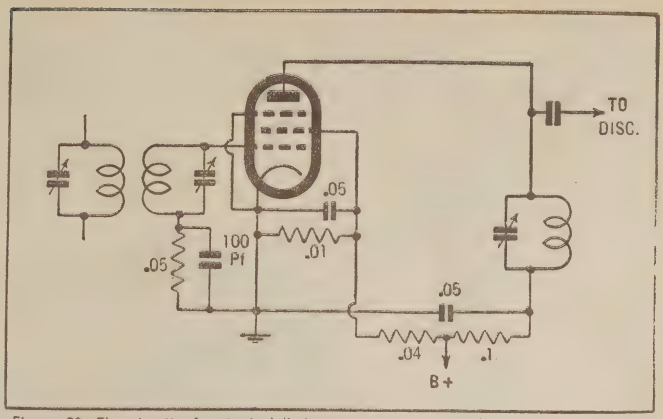

Figure 93: The circuit of a typical limiter stage using, normally, a sharp cut-off RF pentode. Both plate voltage and screen voltage are deliberately restricted to prevent the valve from handling large amplitude signal peaks.

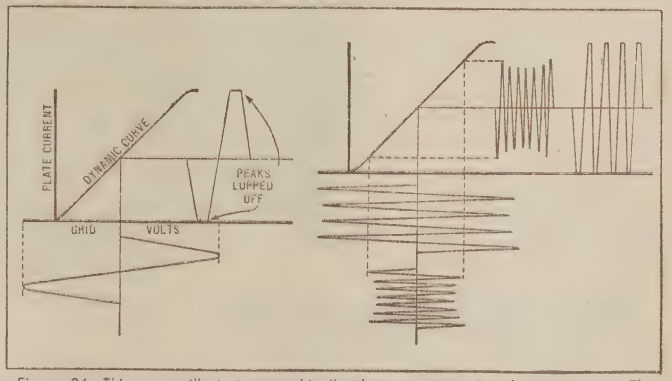

Figure 94: This curve illustrates graphically the operation of a limiter stage. The diagram on the left indicates the way in which large amplitude signals are clipped but not low-amplitude signals which fall within the dynamic limits of the stage.

from amplitude variations due, for example, to the presence of noise pulses.

It will be equally apparent that limiting will not take place on signals which, for one reason or another, are within the dynamic output limits of the limiter stage.

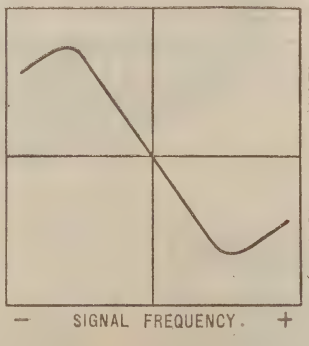

Figure 95: Illustrating the response required from an FM detector. The linear portion should be at least as wide in terms of frequency as the maximum anticipated deviation of the carrier.

It is for this reason that elaborate FM receiving systems often use more than one limiter stage, particularly in FM communication systems, where weak signals are the rule rather than the exception.

Again, some designs provide what is virtually a high-speed AVC action between a limiter and a preceding amplifier stage. This can often be added quite simply.

BIAS VOLTAGE

The bias voltage developed by the grid current in the limiter is fed through a filter of short time-constant to the grid of the preceding stage. The channel gain thus reduces with any rise of signal amplitude and the natural properties of the limiter are supplemented.

It is interesting to note, in passing that the RCA "Personal" TV receiver, recently described in this magazine, uses a simple diode limiter in the input circuit to the intercarrer sound channel.

Readers should have no great difficulty in understanding the foregoing discussion, because it is on fairly obvious and familiar ground. Not so obvious, however, is the operation of the FM detector in its various forms.

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detector" and the "Foster-Seeley discriminator", which we shall proceed to describe.

Part of the complication surrounding an FM detector arises from the fact that the change in a frequency-modulated carrier is much less positive, in effect, than in an AM carrier. In the latter case full modulation varies the amplitude from zero to twice its static value—a variation of plus and minus 100 pc.

In the case of an FM carrier the amplitude is constant, and full modulation represents a change in frequency of less than 0.1 pc. Even referred to the intermediate frequency of a receiver, the deviation is still only about 1.0 pc.

FM CURVE

From this comparatively small percentage deviation the FM detector has to derive a substantial audio signal, and it is little wonder that its design and adjustment are rather critical.

An FM detector has to exhibit a curve similar to figure 95, which shows audio output voltage plotted against deviation of signal input frequency.

The straight portion of the curve must be sufficiently wide to include the maximum frequency deviation, which, in a TV sound channel, is plus and minus 50 Kc. If its characteristic is not linear over this full range the detector will introduce harmonic distortion in the output.

The slope of the curve should also be as steep as practicable, indicating a high audio signal voltage for a given deviation in carrier frequency.

A complete FM detector circuit can really be divided into two parts, namely, the detector valve itself and the IF transformer which feeds it.

With both the ratio and Foster-Seeley circuits the transformer is a specially designed unit, which is particularly responsive to variations in carrier frequency. As we shall see, the key word in considering the operation of this transformer is "phase".

Consider an IF transformer, as in figure 96a, with a tuned primary and a tuned secondary, the latter winding being centre tapped. Signal currents passing through the primary induce voltages in each half of the secondary, which are equal, but 180 degrees out of phase.

The voltages remain equal, whether or not the signal frequency happens to correspond with that to which the transformer is tuned. It is, therefore, of no immediate assistance in dealing with a frequency modulated carrier.

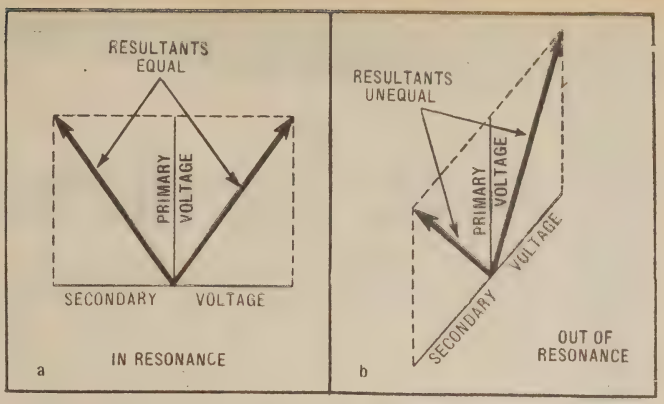

Figure 97: A vector diagram illustrating the phase relationships in a discriminator transformer. In diagram (a) on the left, the resultants are equal when the incoming signal is at resonance; at (b) on the right, the incoming signal is off resonance and the resultant voltages are unequal.

What is obviously required is some treatment of the transformer which will introduce a condition of unbalance between the two halves of the secondary when the signal frequency deviates to either side of resonance.

Having obtained this dependance on signal frequency for balance or unbalance, it is then not a difficult matter to extract the audio component.

Exactly the required effect can be achieved by connecting a capacitor between the "hot" side of the primary winding and the centre tap of the secondary.

TWO EFFECTS

Two effects are now present. A signal through the primary winding will induce out-of-phase voltages in each half of the secondary, exactly as before. In addition, the entire secondary winding, including the outer ends, acquires an RF potential, since it is coupled by a capacitor to the preceding amplifier plate.

The signal voltage at each end of the winding therefore becomes the resultant or combination of the energy imparted to it by the magnetic and the capacitive coupling. This is where phase enters the picture.

When the signal frequency is in resonance with the transformer, the voltages across each half of the secondary, due to magnetic coupling, are exactly equal and exactly 90 degrees out of phase with the primary voltage.

These are combined with the direct primary voltage, introduced by the capacitor coupling, to produce resultant voltages at the transformer ends which have a phase difference but are exactly equal in amplitude.

If you can follow a vector diagram the condition at resonance is indicated by figure 97a.

When the signal deviates from resonance, the voltage applied to the secondary by the coupling capacitor remains substantially the same, but the voltage induced by the magnetic coupling shifts appreciably from its original 90 degree displacement.

At the outer ends of the winding the resultant voltages are no longer equal, the different phase relationship tending to add in one case and cancel in the other.

VECTOR RESULTANT

Referred once again to a vector diagram, we have the resultant shown in figure 97b — an off-resonance signal and unequal voltages at the outer ends of the transformer secondary.

With an FM carrier the signal swings to and fro at an audio rate and differing voltages appear sympathetically at the outer ends of the transformer secondary. The job is half done!

One more point must be made before we pass on. The desired result was achieved by providing normal coupling between the two tuned windings PLUS

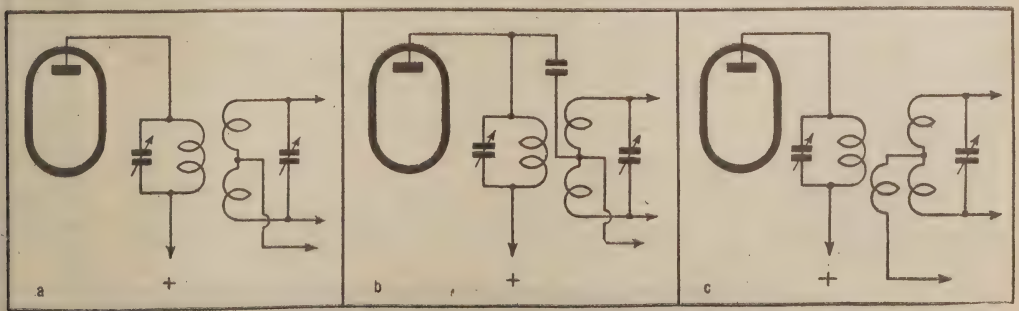

Figure 96: Showing how a conventional centre-tapped IF transformer at (a) is modified by the addition of capacitive coupling (b) and tertiary coupling (c)

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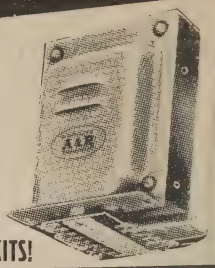

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1769	,,	,, ,, ,,	350 — CT — 350	
1770	,,	,, ,, ,,	385 — CT — 385	
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1772	,,	,, ,, ,,	325 — CT — 325	ditto
1773	,,	,, ,, ,,	350 — CT — 350	5v—3A; 6.3v—3A; 6.3v—CT—3A.
1774	,,	,, ,, ,,	350 — CT — 350	5v—3A; 6.3v—CT—3A; 2.5v—5A.
1775	,,	,, ,, ,,	385 — CT — 385	5v—3A; 6.3v—3A; 6.3v—CT—3A.
1776	175	200 — 230 — 240	285 — CT — 285	
1777	,,	,, ,, ,,	325 — CT — 325	
1778	,,	,, ,, ,,	350 — CT — 350	All in this Section
1779	,,	,, ,, ,,	385 — CT — 385	
1780	200	,, ,, ,,	350 — CT — 350	5v—3A; 6.3v—3A; 6.3v—CT—3A.
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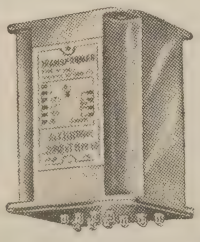

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capacitive coupling to the centre point of the secondary.

Much the same result can be obtained by returning the mid point of the secondary to a tertiary winding tightly coupled to the primary.

The result is the same: A balanced signal at each end of the secondary with the signal in resonance, and a condition of unbalance as the signal deviates in frequency either up or down.

The second section of the detector circuit simply translates the varying condition of balance into audio impulses similar to those which originally caused the frequency swing.

Of the two types of FM detector circuit mentioned earlier, the so-called ratio detector has become established as the preferred circuit for television sound channels.

RATIO DETECTOR

The main reason for this is probably the fact that the ratio detector is not inherently sensitive to amplitude modulation of the incoming signal. It thus lends itself to intercarrier sound channels where, for the sake of simplicity, designers prefer not to rely on multiple limiter stages or other complex arrangements.

The fact that a ratio detector is less "sensitive" or has poorer resolution to FM signals than a Foster-Seeley is not of much consequence, because of the high signal levels and the amplication available elsewhere in the circuit.

Essential features of a ratio detector are shown in figure 98.

The outer ends of the IF transformer secondary are connected to a pair of diode elements, to cathode in the one instance and to plate in the other. The two remaining elements are connected in series with a common load resistor R2, bypassed by a capacitor C2. For convenience, the lower cathode is grounded to chassis.

The tuned secondary is inductively coupled to the primary and a tertiary coil is connected between the centre-tap of the secondary and earth, via a second load resistor and bypass, R1 and C1.

In the presence of a signal, the two series diodes conduct and build up a voltage across R2 and C2, in familiar fashion.

In practice, C2 is made very large, giving a long time constant to the combination.

EQUAL VOLTAGES

Thus the potential across R2 and C2 assumes a certain value for each incoming signal and does not fluctuate with abrupt changes in carrier amplitude due, for example, to superimposed noise pulses.

When the signal is in resonance, as with no applied frequency modulation, the voltage across each half of the secondary is the same, and the centre tap therefore assumes a mean potential approximately equal to half the steady voltage across R2/C2. And this mean potential is likewise present across C1/R1.

The combination C1/R1 is given a time constant such that the potential across it can vary, if necessary at an audio rate, the capacitor C1 being essentially an RF bypass only. In this respect it resembles the diode load of a conventional AM detector.

All this assumes that the signal frequency is in resonance with the IF channel of the receiver, and with the discriminator windings in particular.

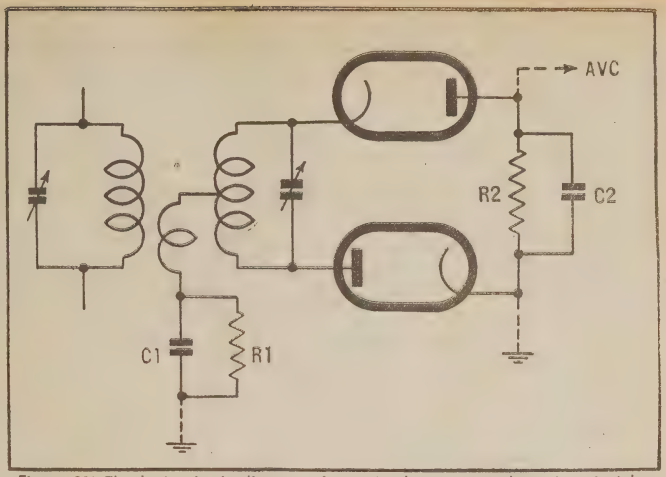

Figure 98: The basic circuit diagram of a ratio detector. Audio output is taken across R1 and C1. AVC or AGC voltages can be derived from R2, C2 if desired.

The moment the frequency deviates from resonance, the balance of voltage across the two halves of the secondary is upset, a greater voltage being present in one half of the circuit than in the other.

However, the total voltage across R2 and C2 is fixed, so that the net effect of the unbalance is to alter the potential at the centre-tap and therefore across R1 and C1.

Thus, as the frequency swings, from one side of resonance to the other, the instantaneous potential at the centre-tap varies in sympathy. This occurs at an audio rate, and the varying voltage appears across R1 as an audio signal.

DETECTOR NAME

The detector derives its name simply from the fact that the audio signal is produced by a varying ratio of voltage across the top half of the secondary and the top diode on the one hand, and the lower half of the secondary and the lower diode on the other.

The total voltage across R2 and C2 remains the same for any given strength of carrier.

A burst of noise as an amplitude modulation, can momentarily alter the current flowing through the two series diodes, but it cannot affect to any extent the steady potential across C2. The proportion of the voltage across the audio load R1 depends still and only on the instantaneous frequency of the signal.

AVC VOLTAGE

In practice R2 is generally made about 50,000 ohms and C2 can be as high as 8 mfd, to give the necessary long time constant.

If desired, the voltage across R2 can be used for "AVC" purposes, better known in television parlance as "AGC" — automatic gain control. It is, in fact, used for this purpose in simple television receivers though modern practice, in more advanced designs, is to use a much more complex circuit.

(The subject of automatic gain control will be discussed separately later in this series).

The audio load R1 can be a 0.5 megohm potentiometer, while C1 may have a capacitance approaching .01 mfd. This gives a diminishing treble response to match the rising treble response which has been accepted as standard practice in FM sound channels.

Next month, we plan to explain the Foster-Seeley and other forms of FM detector, the use of crystal diodes, de-emphasis and audio channels for TV receivers.

AUSTRALIAN TELEVISION CHANNELS

Channel 1 49-56Mc.
Channel 2 63-70Mc.
(For use in inland country areas only)
Channel 3 85-92Mc.
Channel 4 132-139Mc.
(Available from July 1st, 1963)
Channel 5 139-146Mc.
(Available from July 1st, 1963)
Channel 6 174-181Mc.
Channel 7 181-188Mc.
Channel 8 188-195Mc.
Channel 9 195-202Mc.
Channel 10 209-216Mc.

UHF Channels are provisional only, 50 channels being envisaged between 500 and 855Mc. each 7Mc. wide.

Stations which are coming into operation are:

SYDNEY: ABN, National, Channel 2; ATN, Commercial, Channel 7; TCN, Commercial, Channel 9.

MELBOURNE: HSV, Commercial, Channel 7, GTV, Commercial, Channel 9.

All capital cities will use channels 2, 7, 9 and 10 except Hobart which will use channels 2, 4, 6 and 8.

Allocations involving these and other channels have been made to about fifty other cities and/or country centres throughout the Commonwealth.

Figure 1: Derived by AWA Engineers, this map shows the estimated coverage of the Sydney television stations, which are now coming into service. Reports indicate that worthwhile reception is possible in favoured spots well beyond the "B-grade" service limits indicated.

BUILDING YOUR OWN TV AERIAL

Any handyman, with a few hours to spare, can make and erect a perfectly satisfactory television aerial — and save quite a few pounds in the process. This two-part article will explain firstly the how and why of television aerials then, next month, how to build and instal one.

PART ONE

by Neville Williams

A GOOD deal of the basic theory has already appeared in our television course but present interest in the subject, additional information—and the shortage of back-issues—has justified a certain amount of reiteration.

In considering television aerials, three aspects of the subject require examination:

(1) Why special aerials are necessary at all.

(2) How such aerials are designed, and

(3) How typical aerials can be constructed and installed.

The need for special aerials is one which is often queried by readers. Why not use just a piece of wire, as for an ordinary broadcast receiver?

RESUME

The answer to this question is a story in itself, but the essential points can be re-stated briefly.

Because a television receiver is a broadly tuned device operating in the VHF band, it needs an adequate amount of signal input to ensure that the picture shall not be marred by "noise" voltages generated by valves and other components in the receiver itself. This is a first requirement.

Then again, it is important that the receiver be supplied with only ONE signal from the desired station.

This is not a facetious statement, as might appear at first encounter, because multiple signal effects from one cause or another are a real problem in television reception.

Because use of the VHF band involves very short wavelengths, standing-wave and reflection effects can occur in long, random aerial wires.

A particular incoming signal pulse may strike the aerial and be conducted to the receiver's aerial input circuit. If the energy is not completely absorbed by the input circuit, a proportion of the signal may be reflected back along the aerial wire to the free end, only to return after further reflection to the input circuit.

SEVERAL SIGNALS

Each incoming piece of signal information is therefore divided into a weakened initial signal, followed by one or more duplicate signals produced by reflection effects within the aerial system.

On a sound receiver, the effect is not important, because the time delay between original and reflected signals is not long enough to produce an audible result.

On the face of a picture tube, the effect is quite different, because the delay may be enough to produce a second image (known as a "ghost") displaced slightly to one side of the image produced by the original signal.

"Ghost" images can also be produced external to the receiver and aerial, when a large structure or a hill happens to be to one side of the direct signal path between transmitter and receiver. A prominence behind the receiving site can also cause trouble.

Signal impulses arrive at the receiver by the direct path, followed immediately after by duplicate pulses which have been bounced off the reflecting surface.

A simple aerial wire cannot discriminate between the different sources of signal and, being fed by both, the receiver produces a multiple image on the screen.

And, finally, there is the question of electrical interference which can be very severe in congested areas or near a highway. This makes it doubly important to secure as much signal as possible from

the transmitter and, if possible, some discrimination also against the interference.

A suitably chosen aerial system can alleviate these various problems, which naturally become more severe as the distance between transmitter and receiver is increased.

Television aerials are normally designed to be resonant (or approximately so) at the frequencies they are meant to intercept. In practical terms this simply means that the aerial elements are cut to a length which bears some planned relationship to the wavelength of the desired incoming signal.

CONVENIENT

It is possible to do this at very high carrier frequencies (VHF) because the equivalent wavelength amounts to only a few feet, as against hundreds of feet for signals in the ordinary broadcast band.

A resonant aerial ensures good signal nick-up — far better in fact than the pick-up from a longer but random length of wire.

It also has marked directional qualities which can be augmented, if desired, by mounting other elements of selected length adjacent to it.

It is thus possible to face the aerial or aerial system in a direction which will favor the desired signal and discriminate against some external reflection which is producing a "ghost" image on the screen.

At the same time, the aerial can reject electrical interference from directions other than the one in which it is pointing.

The efficiency and directive qualities of a television aerial can be affected by nearby metallic structures, house wiring and even such items as metal venetian blinds. Except in very favorable areas, it is therefore desirable to have the aerial system mounted above the roof line.

The problem then arises of how to connect the aerial to the receiver input terminals, without the connectiong wire itself picking up signals or introducing reflection effects, as already mentioned.

This problem is solved by using a "transmission line" between aerial and receiver, instead of the usual single-wire lead-in.

Transmission line, which is variously known as the "feed-line" or simply the "feeder", usually takes one of two basic forms. These are illustrated in figure 3.

BALANCED LINE

The type of line which is of most immediate local interest is the "balanced" or "two-wire" feeder, as illustrated in diagrams (a) to (d). Two parallel wires are used, embedded in a ribbon of plastic or in the sides of a hollow plastic tube.

The fundamental idea behind such a line is contained in the terms "balanced" and "two-wire".

At the aerial end, the respective wires in the line are connected to points in the aerial system which are equivalent or symmetrical. At the receiver the wires connect to respective ends

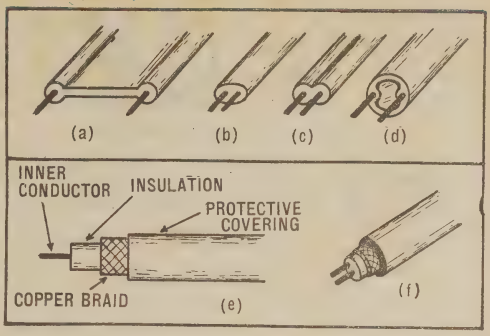

Figure 3: Illustrating the better known types of transmission line or "feed line" as it is often called. The balanced type of line, particularly the types shown as (a) and (d) are likely to be the most popular in Australia because they fit in well with the design of horizontally polarised aerial systems

of the aerial coil primary, the centre of the winding usually being earthed.

It is, in fact, a kind of "push-pull" system, which transfers the signal from aerial to receiver.

Signals which may be induced in the transmission line are induced simultaneously and in the same phase in both wires because they are both exposed and both very close together.

And because the wires are connected to opposite ends of the aerial coil, the unwanted signals simply cancel as far as the receiver is concerned.

The second general type of line, as illustrated in figure 3e, operates in quite different fashion. Known as the "coaxial" feed-line, this has an inner conductor, a layer of high grade insulation and, over this, a woven metallic outer conductor.

It is rather like ordinary shielded hook-up wire, except that the insulation is better and an outer plastic covering is provided to give physical protection.

In use, the outer braiding is "earthed" to the receiver chassis and, as a rule, to a low potential point on the aerial system. It therefore tends to shield the inner conductor, which transfers the signal from aerial system to the receiver's input circuit.

TOO DEAR

Diagram (e) illustrates a balanced shielded line, which combines both the foregoing ideas. It is expensive, however, and not widely used for TV receiver installations.

From the foregoing discussion, it will be apparent that the aerial and the transmission line both serve a very useful purpose in the scheme of things, combining to supply the receiver with a signal which is of adequate strength, as free as possible from "ghost" impulses

Figure 2: Here is the equivalent map of estimated service area for Melbourne TV stations. Note that coverage of channels 1-3 is better than channels 6-10, because of the lower carrier frequencies used.

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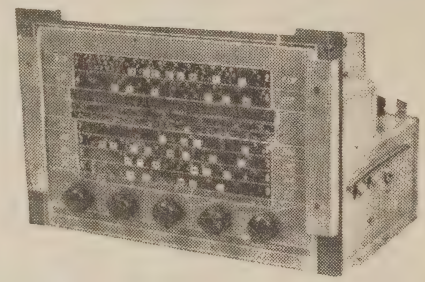

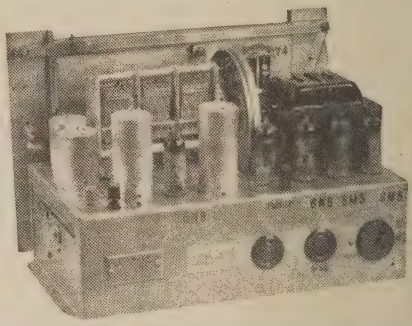

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from any source, and also free from electrical interference.

This leads naturally into the question: "Must all television receivers therefore be provided with a special aerial system?"

If by "special" we mean something more than a couple of feet of wire hanging from the aerial socket then, indeed, most television receivers must be provided with a "special" aerial.

Within about 5 miles of the transmitting site and within sight of it, very simple aerials will often suffice — perhaps nothing more than a couple of spikes protruding from a holder on top of the cabinet and forming a simple resonant system.

Where the signals using such an aerial are on the weak side or affected by the position of metal furniture, metal blinds or electrical circuits, an aerial on the picture rail or attached to the roofing rafters may be preferred.

EXTERNAL AERIALS

Further away from the transmitting site and over most of the suburban area, simple roof-top aerial systems are more commonly employed. These should be quite adequate within the "A-class" service zones suggested by figures 1 and 2.

In the "B-class" service area, more elaborate systems may be necessary, a great deal depending on local topography.

So much then for the question of why special television aerials are necessary. What are the technicalities behind a "resonant" aerial system?

The simplest resonant aerial, and the starting point for almost any design, is the half-wave "dipole". This is simply a piece of wire or metal rod having a length which is approximately equal to one half wavelength at the frequency of operation.

It is normally broken in the centre to allow wires from the feedline to connect one to each half. (See figure 4.)

By way of example, the centre frequency of television channel 7 is 184.5Mc. To obtain the equivalent wavelength in metres, this figure should be divided into 300, giving the answer 1.63 metres. A dipole resonant at this frequency would therefore need to have an aproximate length of half this, equal to 0.815 metre.

It would be divided at the centre to allow connection of the feedline, so that each half would be approximately equal to one quarter wavelength or 0.407 metre.

CORRECTIONS

The word "approximately" is used deliberately, because, after allowance is made for various secondary effects, the optimum length of a simple dipole usually works out at about 0.95 of the calculated figure.

To convert metres to more familiar units of length (to us anyway) the following relationships can be borne in mind:

2.54cm equals 1in.
30.48cm equals 1ft.
1 metre equals 39.37in.

The correction to feet and the 0.95 correction factor can be combined to produce the following simple rule:

The length of EACH HALF of a resonant dipole, expressed in feet, can be obtained by dividing the frequency in megacycles into 234.

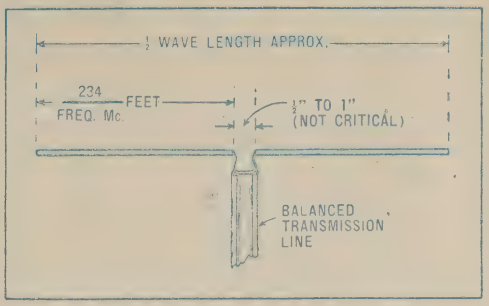

Figure 4: This diagram shows the essential dimensions of a half-wave resonant dipole. Nominal centre impedance is 73 ohms. The inner ends of the dipole need to be insulated one from the other and from the metal support boom, if such is used.

Thus a resonant dipole cut for the centre of Channel 2 is made up of two sections equal to 234/66.5ft. This works out at 3.52ft, or 3ft 6¼in.

Similarly a dipole for Channel 7 has two halves each 1.27ft, equal to 1ft 3¼in.

For Channel 9, the figures work out at 1.18ft, equal to 1ft 2in—dropping the rather inconsequential fraction.

AERIAL IMPEDANCE

Before one can say much more about the basic dipole, it is necessary to interpose a few remarks about its impedance characteristics. This is necessary because a dipole has to be considered as a source of signal, which feeds into a transmission line and thence into the primary winding of the receiver's aerial coil.

It thus resembles many instances in radio and electrical theory where "generator", "line" and "load" have to be related in terms of voltage, current—and impedance!

The question of aerial system impedance is a very involved one which, on an elementary basis, frequently puzzles the newcomer. On a more advanced basis, it leads to endless arguments about the effect on impedance of aerial height above ground, proximity to other metal structures and so on almost ad lib.

It is not our aim here to become involved in all this.

As a simple approach it may be helpful to consider first the aerial coil primary winding, which is the destination of the incoming signals—the "load", in other words.

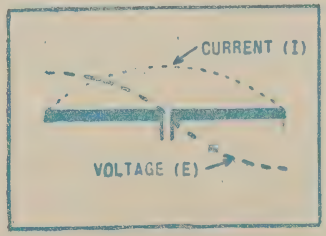

Figure 5: When a dipole is excited at its natural resonant frequency, the RF voltage is highest at the ends and lowest at the centre. Conversely, the RF circulating current is low at the ends and high at the centre. Relating these quantities gives the apparent impedance at various points

This could be wound with several turns and be intended to receive the signal energy at high voltage but low current. Based on an Ohm's Law relationship, it could be called a "high impedance" winding.

Or it could be a "low impedance" winding, with fewer turns and intended to accept the signal input at a lower voltage but higher current.

The idea of high impedance or low impedance primary windings will not be a new one to many readers, being encountered in ordinary broadcast and shortwave coils.

Coming to the transmission line, much the same can be said.

Some transmission line is better suited to carrying signal energy at higher voltage but lower current, in which case it could be said to have a high "characteristic impedance". Conversely, it may be designed to have a low characteristic impedance, carrying signals more efficiently at lower voltage but higher current.

LINE IMPEDANCE

The characteristic impedance of a transmission line is dependent on the diameter and spacing of the conductors and the nature of insulating medium between them. Mathematically it can be analysed in terms of the inductive and capacitive qualities of the line, but there is no need to pursue this just here.

In practice, transmission lines are manufactured to a variety of impedance figures. The most common ones are 50 and 70 ohms for coaxial lines and 70, 150 and 300 ohms for balanced lines.

Ideally, the transmission line and the receiver's input system should be designed to work together, to ensure the most efficient transfer of signal energy and, incidentally, a freedom for internal reflection effects.

In the first place, the two should have a similar impedance characteristic.

Secondly, for proper electrical connections, the receiver input circuit should either be a two-terminal balanced arrangement or have one side earthed, according to whether a twin-lead or a coaxial line is to be used.

Local practice is to design receivers with a nominal 300-ohm balanced input system and to assume the use of a 300-ohm feedline of one type or another.

To complete the picture, it is not difficult to foresee that the aerial system itself should ideally have an impedance

THE BJ ARM

Technical Report by P. WILSON, M.A.:, *quoted from* THE GRAMOPHONE:

It is beautifully made, and indeed is an example of precision workmanship. Notwithstanding the four extra pivots, the lateral motion is without play and as sleek as velvet.

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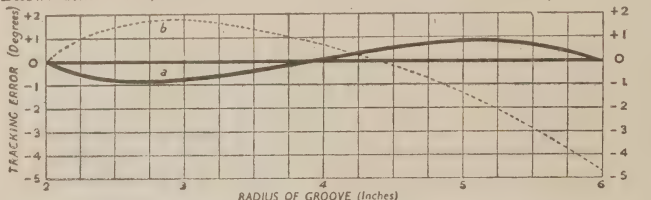
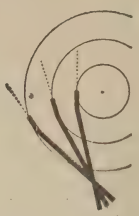
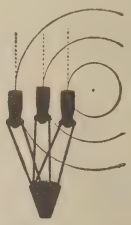




INCORRECT TRACKING with Conventional Arm.



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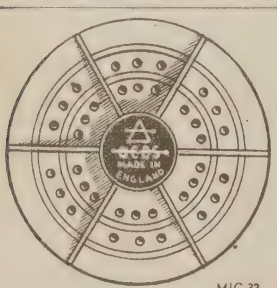

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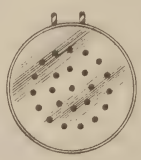

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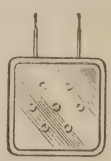

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characteristic which is of a suitable order to feed into such a line.

Broadly speaking, the need for an exact impedance match is not as great in a television receiving aerial as it is, for example, in aerial systems used by amateur stations operating on the VHF bands. However, it cannot by any means be ignored, particularly for the higher frequency channels.

The idea of an aerial having an impedance characteristic will be a new thought to many but it is, in fact, very important.

If a dipole aerial is excited at its resonant frequency, RF current circulates through it and RF voltage is present across it in much the same fashion as for an ordinary tuned circuit.

CENTRE IMPEDANCE

At the ends, as illustrated in figure 5, the signal voltage is greatest but the circualting current is lowest. In the centre, the voltage is low but the current is high.

Translated into terms of impedance, this simply means that, as a source of signal, the aerial exhibits a high impedance at the ends and a low impedance at the centre.

In actual fact, a simple resonant dipole has a characteristic RF impedance of about 73 ohms, considered between the inner ends of the two halves.

This figure has virtually nothing to do with DC resistance between these points—any more, in fact, than the DC resistance through the coil or across a capacitor in a tuned circuit.

It simply means that the RF energy fed from the dipole into the line appears to be coming from an RF "generator" having an internal impedance of 73 ohms.

This is for a simple resonant dipole, as illustrated in figure 4. As we shall see later, the impedance is different when the dipole is receiving signals at a multiple of its natural resonant frequency, or when other aerial elements are mounted adjacent to it for special purposes.

The impedance can also be changed deliberately by modifying the shape of the dipole elements.

The mounting position of a dipole is important, as well as its length.

Television signals radiated by Australian stations are horizontally polarised, which simply means that the electrostatic field of the radiated signal is parallel with the earth's surface.

POLARISATION

Polarisation is not very important at medium frequencies but, in the VHF and UHF band, receiving aerials should be polarised to suit the transmitted signals.

With very few exceptions, this means that the dipole or any other elements associated with it should be mounted predominantly parallel with the earth's surface, rather than vertically.

A horizontally mounted dipole has greatest signal pickup at right angles to itself, falling away to near zero off the ends.

In fact, the natural signal pickup pattern of a dipole can be represented by writing a large figure 8 on a piece of paper and then drawing a short horizontal line through its centre. The line represents the dipole and the figure 8 its "field pattern".

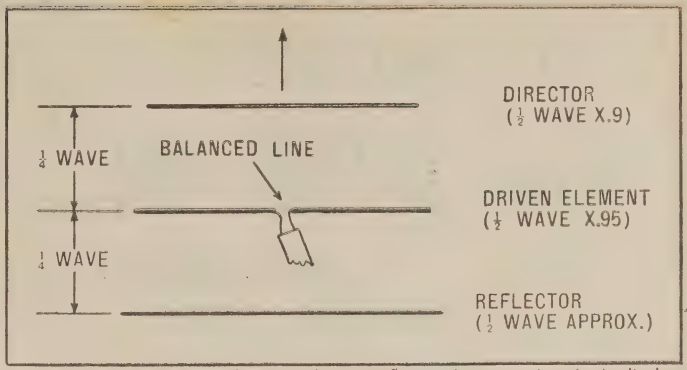

Figure 6: A three-element beam, involving a reflector, director and a simple dipole as the active element. In many cases this latter is replaced by a folded dipole in order to raise the apparent impedance of the aerial system to a more convenient figure.

In many cases, useful (and sufficient) directivity can be obtained from a simple dipole by mounting it aproximately broadside on to the transmitting site and with a "dead" end zone toward a possible source of interference or image signal.

Even where directive properties may not specifically be needed, dipole aerials normally have to be faced in a direction which will favor and not discriminate against the incoming signal.

Where necessary, the directional properties of a dipole can be augmented in a variety of ways. Perhaps the simplest is by the provision of one or more "parasitic" elements of selected length adjacent to it.

The elements are called "parasitic" because they do not rely for their operation on any electrical connection to the dipole or its associated transmission line.

They operate as they do, purely because they distort the field pattern around the dipole proper.

Parasitic elements are normally spaced away from the dipole by a distance of between one-eights and one-quarter of a wavelength, at the operating frequency. Quarter-wave spacing is the more usual for television receiving aerials.

A parasitic element which is about 5 pc longer than the dipole at the operating frequency acts as a "reflector". It distorts the field pattern so that the system picks up signals efficiently from the side of the dipole remote from the reflector.

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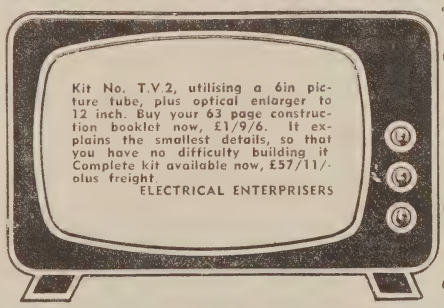
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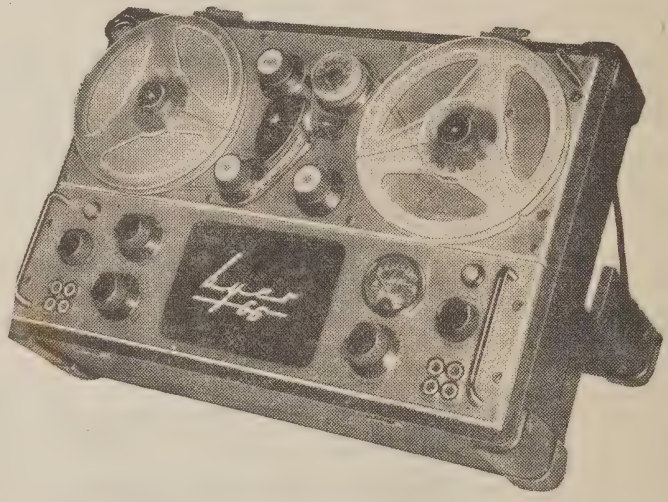

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It is interesting to note that the reflector works out to an optimum length about equal to a calculated half wavelength. This must be so, because it is 5 pc longer than the dipole which, as explained earlier, is normally shortened by this amount.

The overall length of a reflector in feet is given by dividing 492 by the operating frequency in megacycles.

A parasitic element which is about 5 pc shorter than the dipole at the operating frequency acts as a "director", causing the system to be most sensitive to signals on that particular side.

Optimum length for a director in feet is obtained by dividing 444 by the operating frequency in megacycles.

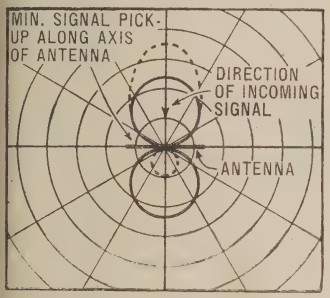


Figure 7: The polar diagram — or signal pick-up pattern — of a simple dipole (solid curve) and a directional beam (dotted curve). A directional aerial is most helpful in eliminating "ghost" images from surrounding terrain and also for discriminating against noise.

Directional aerial arrays may use a dipole with either a reflector or a director, to make up a two-element beam. If reflector and director are both used, the result is a three-element beam, often described as a "Yagi" array.

Figure 6 shows the essential details of a basic Yagi beam aerial, using a reflector, director and a simple dipole as the active element.

Figure 7 illustrates the field pattern of a simple dipole aerial (solid curve) and the way in which this is changed to a predominantly single-lobe pattern by the addition of one or more parasitic elements.

The foregoing discussion is all on the assumption that the aerial system has to operate at a particular frequency, being the frequency of resonance for which it has been designed.

MANY CHANNELS

The problem which faces television viewers is to instal (or have installed) an aerial system which will operate with reasonable efficiency on not just one frequency, but on the several frequencies used by different television stations. This greatly complicates matters.

As a result of this special requirement, the basic aerial designs so far described have been modified in a variety of ways to achieve "broad-band" characteristics.

Some of these measures can be listed as follows:

(1) Compromise figures are selected for element lengths on the basis of them being "near enough" for two or three adjacent channels.

(2) The shape of the dipole in particular is varied to increase its natural bandwidth. Most of the schemes, as illustrated in figure 8, involve increasing its effective bulk.

(3) Use is made of the fact that a dipole can respond to frequencies which are multiples of the frequency for which it is cut.

(4) Elements cut for distinctly different frequency groups are often mounted together in the one assembly and connected to a common transmission line. If mutual interference does occur, efforts are made to minimise it by judicious "pruning".

(5) Deliberate mismatch to the feeder is sometimes allowed to lower the "Q" of the system and thereby increase its bandwidth.

Generally, such measures involve some loss of performance over the simple, ideal case but, in most locations the compromise does not prejudice performance as judged by the final picture.

Any such loss is far outweighed by the advantage of having a single compromise aerial system which does not need to be adjusted when tuning from one television channel to the next.

In fringe areas, where there is nothing to spare in the way of signal strength, all-band aerial systems are often "stacked" to produce a rather fantastic all-band array. Either that, or separate aerials are used, one for each required channel or group of channels.

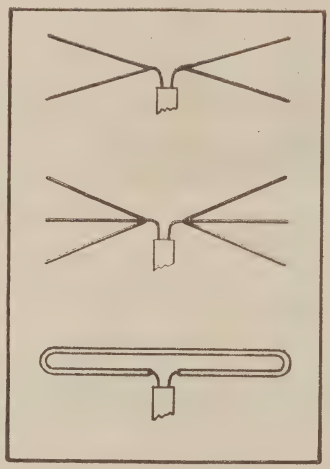
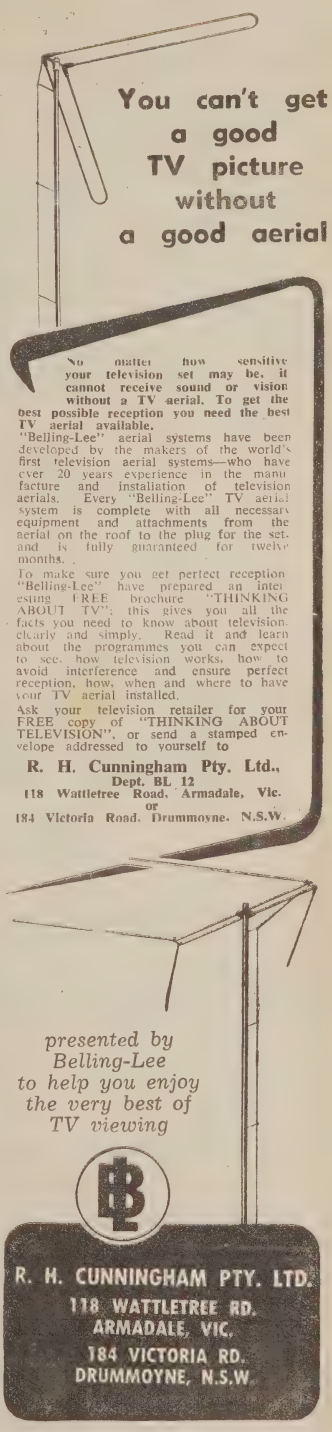


Figure 8: Increasing the bulk of a dipole, without increasing its overall length generally has the effect of imparting greater bandwidth. Top is a two-finger fan, centre is a three-finger fan and bottom a folded dipole.

Many and varied are the answers which have been proposed to the conflicting problems of cost, complexity performance and bandwidth. In the course of time, many of these will be bought or constructed by R. T & H readers but, in the meantime, certain basic aerial types can be considered as being of immediate interest.

Next month we shall tell you how to make and erect them for yourself.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Germanium diodes are occupying an increasingly important place in electronics, due to their much improved characteristics of recent years and hence their superiority over the conventional thermionic diodes in many applications.

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Dr. Boon's treatment is essentially a practical one, beginning with a brief history of the germanium diode and, where appropriate, comparing it with its thermionic counterpart. This is followed by characteristic curves, video detector efficiency curves where applicable, and derating curves for high-temperature operation. The accompanying explanatory notes, which often do not appear with the published data, will be found particularly valuable.

Practical circuits with typical component values appear throughout the book. Among these are AC voltmeters, video detectors, DC restoration circuits, amplitude limiters and simple receiver circuits. We feel that the book will fill a definite gap in previously existing information.

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MORE ON TRANSISTORS

TRANSISTOR APPLICATIONS — more than 50 practical circuits using Raytheon CK722 transistors, published by the Raytheon Manufacturing Co., USA. Soft cover 11in x 8½in; 116 pages. Australian price, 12/6.

The book is largely a reprint of practical articles published in the two American periodicals, "Radio-Electronics" and "Radio and Television News". Circuits of various types of receivers, audio amplifiers, timing circuits, oscillators, hearing aids, etc., are included. It is worth noting that transistors with characteristics virtually identical to the CK722 are readily available locally.

A good percentage of the projects included appear to be well considered and capable of doing a good and permanent job. On the other hand, there are some which we suspect would fall more into the "five-minute novelty" class.

All serve a useful purpose in that they help to familiarise the reader with the advantages, peculiarities and limitations of transistors and we can recommend the book to readers who are anxious to expand their knowledge in this new field.

Characteristic curves for Raytheon transistors are included.

Our copy from the Technical Book and Magazine Co., 295-297-299 Swanston St., Melbourne (MVF).

GOOD FOR TV WORKERS

THERE have long been technical textbooks to help newcomers in the TV engineering field to learn their subject and understand the new techniques involved.

Not so easy to find have been good manuals on the other aspects of TV, particularly the handling of programmes. There must be many people in Australia looking for something like The Television Programme, by Edward Stasheff and Rudy Bretz, a copy of which we have received from the publishers, Hill and Wang Inc. New York.

Its 356 pages are filled with concisely written and practical information, commencing with a description of the New Medium, through script writing, program production, selling of script, and putting the show on the air.

This is a down-to-earth manual, profusely illustrated with action pictures to amplify the text, sample scripts, their correction and editing, their combination with musical scores, the handling of cameras and films, and that most difficult of programs, the news service.

The analysis of all these things is, of course, typically American, but because so much of our TV will be commercial, they have an added value in placing this type of experience at the service of those whose work lies in similar fields in Australia.

Both authors have had wide TV experience in executive posts, and both have served with various organisations concerned with training for TV. Their book has been adopted by over 60 American universities and colleges.

At the same time it is written to hold the reader's interest, making it equally valuable for general reading by anyone interested in television and its production.

TV Telephone Nearer

(Continued from page 9)

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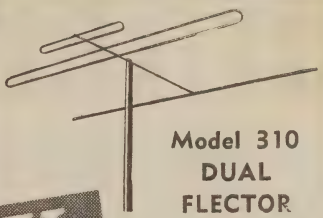

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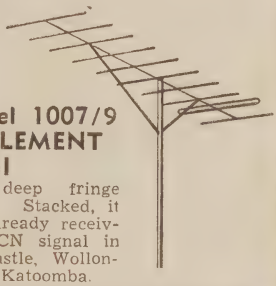

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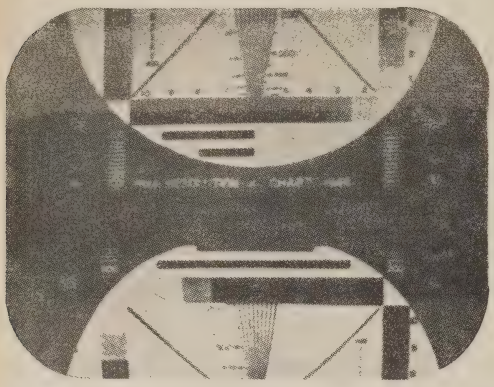


Figure 1. The effect of an improperly synchronised vertical oscillator. There is a black band where the two halves of the picture join, due to the blanking signals sent out by the transmitter between fields.

Figure 2. Here the line oscillator is out of synchronisation and gives the appearance of the picture being torn and slanting sideways. The pattern consists of crosed black bars. From Philips Technical Library "Introduction to TV Servicing."

The preceding article discussed the Australian Television Standards and pointed to some of the considerations which influenced the Australian authorities making a choice of the number of lines, bandwidth and other details. We now conclude with a discussion of the synchronising signals, a subject not always well understood.

THE need for synchronisation between the scanning systems at the transmitter and receiver is fairly clear.

For example, if the light spot focused on the screen of the receiver cathode-ray tube does not begin its downward excursion until the transmitter scanning system has covered half the picture, the scene shown on the receiver will appear cut in half, with the top and bottom halves transposed.

DANGER OF DRIFT

In practice an unsynchronised oscillator in the receiver would drift continuously with the result that the picture would drift up or down the screen depending on which of the two oscillators was at the higher frequency.

If the two oscillators differ in frequency by only a small amount, the picture will run slowly in a vertical direction, while a big frequency difference will result in a quick change which gives the effect of a picture printed on a continuous roller blind running at high speed.

If the frequency of the horizontal time-base is not correct the resultant picture will have the appearance of being torn apart and slanting on the screen. This is because information transmitted by the station and intended for, say, the left hand side of the picture is transferred slightly to the right, the amount of the displacement becoming greater as the spot progresses further down the picture.

The effects of lack of synchronisation could be discussed in more detail and we recommend that servicemen become familiar with the appearance of the picture under different faulty conditions, in order to speed up fault finding.

Our main point at the moment is to remind readers of the need for synchronisation and therefore to justify the relatively complicated circuits which are necessary to make the electron beam of the receiver picture tube follow accurately the excursions of the scanning beam of the camera tube at the transmitter.

As mentioned last month frequency modulation is used to transmit the sound accompanying the picture. All the picture and synchronising information is transmitted by varying the amplitude of the picture carrier.

Most of us tend to think of the usual broadcast station modulation where the modulating wave is usually symmetrical and tend to be confused thereby. If a broadcast transmitter is modulated 100 pc with a sine wave, say, the instantaneous carrier amplitude is alternately doubled and halved.

It is not permissable to reduce the television picture carrier amplitude to zero because the 5.5 Mc beat note between picture and sound carriers would then no longer exist and the sound channel would be interrupted.

PERCENTAGE AMPLITUDE

In thinking of television modulation it is best to think in terms of percentage of maximum carrier amplitude. In these terms the A.B.C. Board's standards state that the minimum carrier amplitude must be within the limits of 10 pc and 15 pc of the maximum carrier amplitude. This maximum carrier amplitude is transmitted at the peak of the synchronising signals.

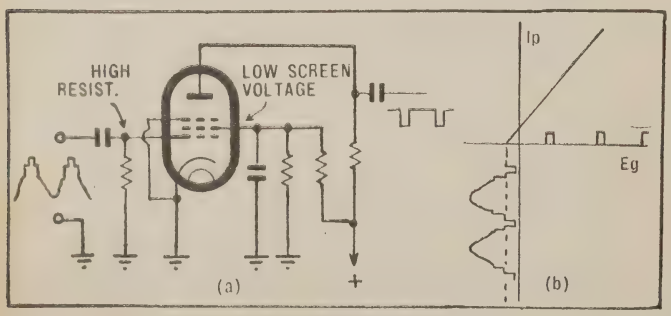


Figure 3. One means of separating the synchronising signals from the video information is to operate a valve with a high grid return resistor and low screen voltage. Grid current will cause a high bias to be developed so that grid and plate current will flow only on the peaks of signal, i.e. the sync pulses.

Information contained in the detail of the picture is transmitted by varying the carrier amplitude between 10 pc and 75 pc of the maximum. The circuits are arranged so that 10 pc corresponds to white. levels between 10 pc and 75 pc to various shades of grey with 75 pc corresponding to black.

Any increase in carrier level from the black region has no visible effect on the screen because the electron beam in the picture tube is cut off. Therefore by transmitting "blacker than black" signals at the end of each line and at the end of each field, synchronising information for the receiver can be provided without interfering with the picture.

SEPARATION OF SYNCH.

These synchronising signals can be separated from the picture information simply by including some device which responds only when the carrier amplitude is greater than 75 pc of maximum.

One simple means frequently employed is to operate a valve wtih high bias so that plate current flows only at the required level. The output from this valve can then be dealt with separately and the information passed on to the circuits controlling the operation of the line and field sweep generators.

It does not matter if the synchronising signals are passed on to the picture tube grid, since the electron beam is cut off in any case. However, picture information must not be passed through the sync. separator, since picture information may then cause the line and field oscillators to trigger at the wrong time and give effects similar to those mentioned at the beginning of the article.

STANDARDS DIAGRAM

As you will see later, a sudden change from white to black could cause the line oscillator to trigger sooner than normal if picture information were allowed to pass through to the differentiating circuit.

(Continued on Page 77.)

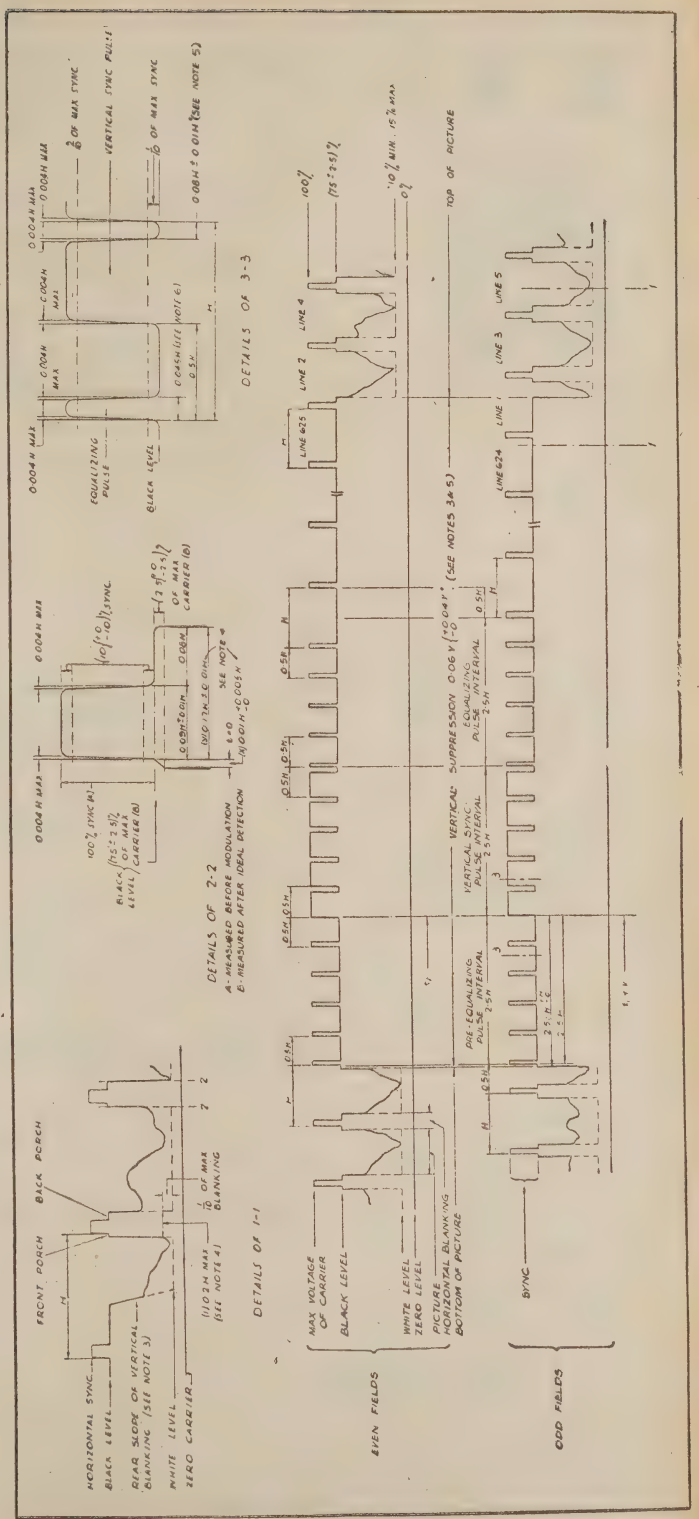
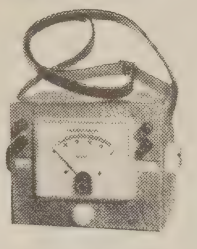


Figure 4. Details of the synchronising signals for the Australian television system.

1. H equals the time from the start of one line to the start of the next line.
2. V equals the time from the start of one field to the start of the next field.
3. Leading and trailing edges of vertical blanking should be complete in less than 0.1H.
4. Leading and trailing edges of horizontal blanking should be steep enough to preserve min. and max. values of (x plus y) and (i) under all conditions of picture content.
5. Dimensions marked with an asterisk indicate that tolerances given are permitted only for long time variations and not for successive cycles.
6. Equalising pulse area shall be between 0.45 and 0.5 of the area of a horizontal sync. pulse.
7. The values of H and V should not vary by more than plus or minus 0.1 pc from the assigned values.
8. This wave represents the carrier video envelope before the lower sidebands are attenuated and not necessarily the video waveform at the transmitter input.

T.V.



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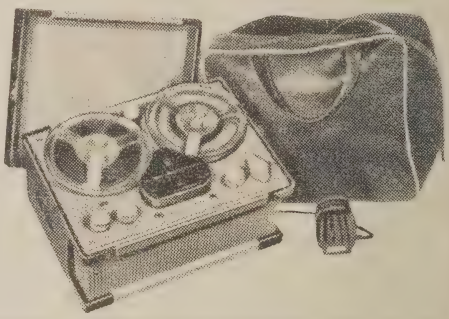

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Figure 4 is a reproduction of the A.B.C. Board's official standards. All the special tolerances given have special significance and a detailed study is required to extract all the information given and relate it to the design of a complete receiver.

Before going any further into the matter we would well repeat the portion of the Australian television standard which comes under the heading:

Picture modulation

Type of Modulation—

"The carrier within a single television channel with both picture and synchronising signals shall be amplitude modulated, the synchronising and picture modulation occurring alternately on a time division basis in accordance with the drawing. The waveform shown represents the carrier envelope at the transmitter output before the lower sideband is attenuated.

Modulation polarity

"Negative modulation shall be employed; that is, a decrease in initial light intensity shall cause an increase in radiated power.

Brightness

"The black level shall be represented by a definite carrier level independent of light and shade in the picture.

"The transmitter output shall vary in substantially inverse logarithmic relationship to the brightness of the subject. No tolerances are specified at this time.

BLACK LEVEL

"The transmitter shall transmit the black level at 75 pc of the peak carrier amplitude with a tolerance of 2.5 pc of the peak carrier amplitude. The black level shall be as nearly equal to the pedestal level as the state of the art will permit.

Line Frequency—

"The line frequency shall be maintained at 15,625 cycles per second plus or minus 0.1 pc.

White Level—

"In the modulation of the picture transmitter, the radio frequency signal amplitude for maximum white shall not exceed 15 pc nor less than 10 pc of the maximum carrier amplitude."

All complete and precise in the official language.

After the synchronising signals have been separated from the picture information we are left with the waveform shown at Figure 5a which, when suitably treated, can be used to control precisely the electron beam in the picture tube and keep it exactly in step with the electron beam in the camera tube at the transmitter.

But first the information to control the line oscillator and that to control the field oscillator must be separated.

DIFFERENTIATION

This is done by subjecting the synchronising waveform of Figure 5a to operations known respectively as "differentiation" and "integration".

These two terms are perhaps a little frightening because of their association with mathematics but you do not need to be a mathematician to understand how differentiating and integrating circuits are applied in television receivers in a qualitative way at least.

The differentiating circuit is shown at Figure 5b. By making R and C small the output voltage will be proportional to the rate of change of the input voltage. In other words if a sharp pulse is applied to the circuit it will respond with a large output but if the input waveform is slow to change its value the response will be small.

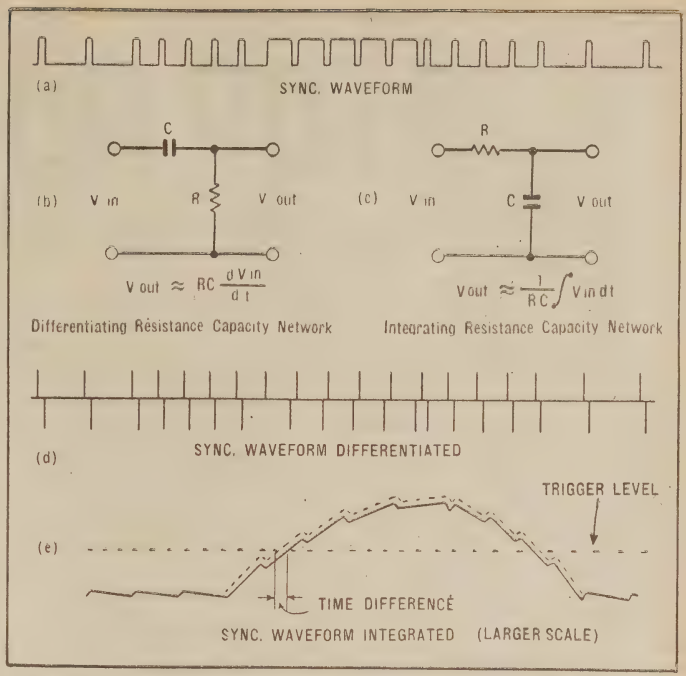


Figure 5. After separation from the video signal, the sync pulses treated so that they

Figure 5. After separation from the video signal, the sync pulses are treated so they

The circuit arrangement is the same as is used in ordinary resistance-capacitance coupled amplifiers but the values are chosen so that only the high frequency components are passed. For an audio amplifier the circuit constants may be chosen so that all components above, say, 30 cps are freely passed. In the case of a television differentiating circuit only signals of the order of megacycles are passed freely.

The integrating circuit of Figure 5c produces an output voltage which responds only to slow variations in the input signal. It is like the filter in a power supply in that it tends to attenuate the high frequency components and deliver an output voltage proportional to the average level of the signal.

When the synchronising signal of Figure 5a is fed into the differentiator of Figure 5b and the integrator of Figure 5c the outputs are respectively those of Figure 5d and Figure 5e.

Consider first how the horizontal, or line, oscillator is controlled. If you study Figure 4 you will note that there is a positive-going pulse from the differentiator at the beginning of every line.

OSCILLATOR CONTROL

Actually while the vertical, or field, signals are being transmitted there is a positive-going pulse in the middle of the line. This does not upset the operation of the line oscillator, since it is arranged to operate only due to the required frequency and is sensitive only to triggering signals applied just before it would be ready to trigger of its own accord in any case.

The main thing to understand is that the operation of the line oscillator is controlled at the end of each line by the output of the differentiator. The negative-going pulses at the end of each line pulse may not do any harm but if required they can easily be clipped off by a valve which does not respond to negative-going signals. The reason for the additional pulses in the region of the vertical synchronising signals will be discussed in a moment.

EXTERNAL TRIGGERING

Like the line oscillator, the field frequency oscillator is arranged to run at about the required frequency without any synchronising but can be triggered exactly into step by the application of an external signal. This signal is the output of the integrator which rises appreciably only when the five long pulses of the vertical synchronising signal are transmitted.

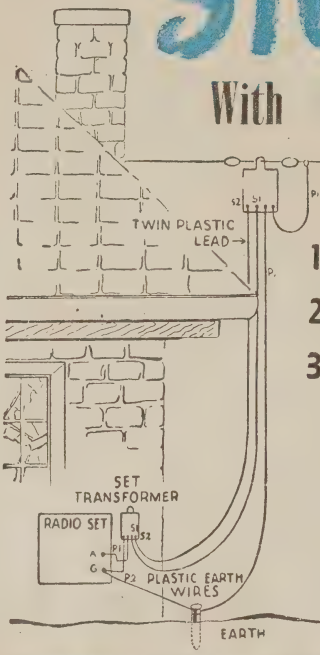
The vertical oscillator will trigger at some definite voltage which is indicated by the horizontal broken line of Figure 5e. This will occur at the end of each field. (Time intervals of 1-50th sec.)

The total number of picture lines is 625 and each picture is divided into two fields in order to provide interlaced scanning, as discussed last month, so that the beginning of every second field pulse interval must be halfway between line pulses.

Each field then consists of 312½ lines. Of these you will see, by the way, only about 300 are active, because the video level is black or blacker-than-black for a portion of the time.

STOP NOISE IN YOUR SET

With R.C.S. aerial and line filters

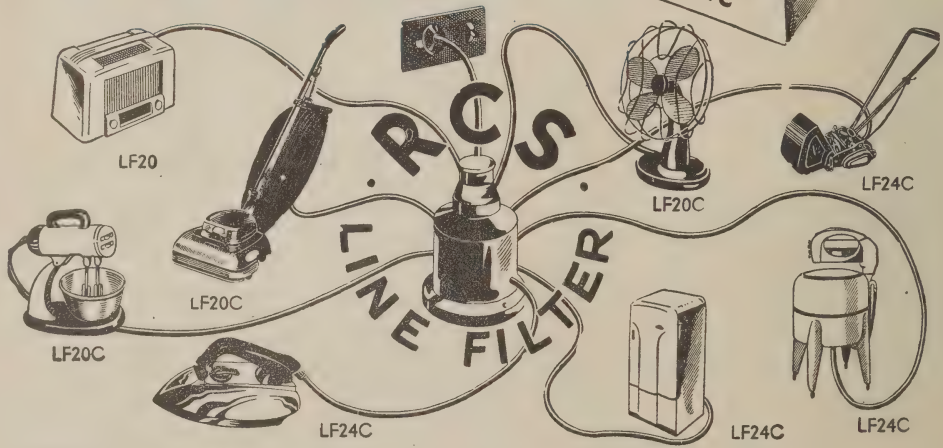


MAKE THIS SIMPLE TEST:—

1. Remove aerial from set. If the noise stops, you need an AF21C aerial filter, as the noise is coming through your aerial.
2. If the noise continues, you need an LF20 line filter as the noise is coming through your power main.
3. If any of the appliances shown below are causing the noise, then fit to it a line filter of the type shown.

AF21C aerial filter
LF20 line filter
LF20C line filter
LF24 line filter
LF24C line filter

CONFINE NOISE WHERE IT STARTS — WITH R.C.S. LINE FILTER



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The reason for the series of short pulses before the field pulses can now fairly easily be explained. The signal is such that the differentiator delivers an unbroken chain of line pulses so that there must be at least one pulse before the beginning of the odd field synchronising signal and the field synchronising signal itself must be serrated in order to maintain the continuity of line pulses.

The other point is that the time of triggering of field oscillator is critically dependent on the level of the output voltage from the integrating circuit. For the triggering to be accurately displaced by half a line relatively the output voltage from the integrator must reach the required level at exactly the correct time.

TRIGGER TIME

Although the effect of the line pulses on the integrating circuit is small they do have sufficient effect to alter slightly the time of triggering. If no special provision were made the field pulse which occurs at a time interval of only half a line after a line pulse would reach the critical value for triggering slightly sooner than the alternate field pulse.

The result would be that the lines for the odd fields would not be placed accurately between the lines of the even fields. This phenomenon is known as "pairing".

It is overcome by placing five short pulses ahead of the field pulse. These pulses maintain the line synchronising, allow the field signal to start between lines on the odd fields and, most important, ensure that the level of the integrator output is the same at the start of the field pulse.

The time displacement caused by an initial difference in level at the output of the integrator is shown by Figure 5e. You will note at the same time that, from the point of view of timing, it is desirable that the level for triggering be set well below the final integrated value where the slope of the curve is relatively steep. If the triggering occurs well up the curve a small difference in initial voltage results in a relatively large difference in time.

GENERAL PICTURE

The foregoing should be sufficient to give you a general picture of how the receiver circuits are kept accurately in step with the transmitter. However, a study of the details of Figure 4 will reveal that the shape and size of the pulses is specified and must remain within certain tolerances. After you have fully grasped the general principles of synchronisation, an appreciation of these details is helpful in obtaining the best results from a receiver.

For example, in the details of 2-2 Figure 4, you will note that the time from the start of the line pulse to the end of the blanking period is 0.17 of the time of one line. It is necessary to allow this amount of time in order that the electron beam can move from the right back to the left-hand side of the screen again to begin tracing the next line.

No doubt with specially-designed equipment the flyback time could be made less than this but allowance must be made for the poorest equipment which could reasonably be regarded as good enough.

From the receiver designer's point of view the component most likely to limit the minimum flyback time is the line output transformer. Even when 1-6 approx. of the line time is allowed for flyback, careful design is necessary in order to make sure that the spot has returned to the left-hand side of the screen and ready to begin its forward sweep before the picture information appears.

Similarly in the case of the vertical oscillator sufficient time must be allowed for the spot to return to the top of the screen before the next field. This accounts for the number of lines after the vertical synchronising block which are maintained at black level. Otherwise the return trace would be visible in the form of a line from bottom to top and extending from side to side of the screen.

TRANSMITTER DESIGN

You may already have noticed that some of the equalising pulses appearing after the vertical pulses are not strictly necessary and that the requirements of both line and field synchronising in the receiver would be fully met in receivers of modern design if the normal line pulses were resumed, say, 2 lines earlier.

The tolerances specified in connection with the pulses indicate what can reasonably be transmitted. In many cases there would be nothing to stop the station operator from transmitting shorter rise times but the standards indicate the minimum performance allowable.

Looking again at the detail of Figure 4 you will note that the width of an equalising pulse is about half the width of a line pulse. As mentioned before, the aim is to make the conditions at the output of the integrator as nearly as possible equal at the start of the wide field pulses in order to prevent pairing.

EQUALIZING PULSES

Although small, the line and equalising pulses do have some effect on the integrated output. By making the pulses half as long and doubling the frequency the integrated value over a period remains constant.

A minimum size for the equalising pulses is set by consideration of the behavior of the synchronising in the presence of noise. Under good conditions a pulse rising to the full value in a

(Continued on Page 93.)

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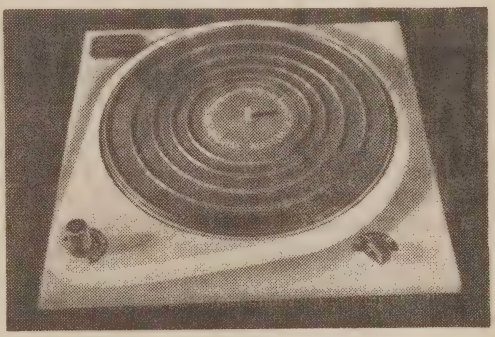

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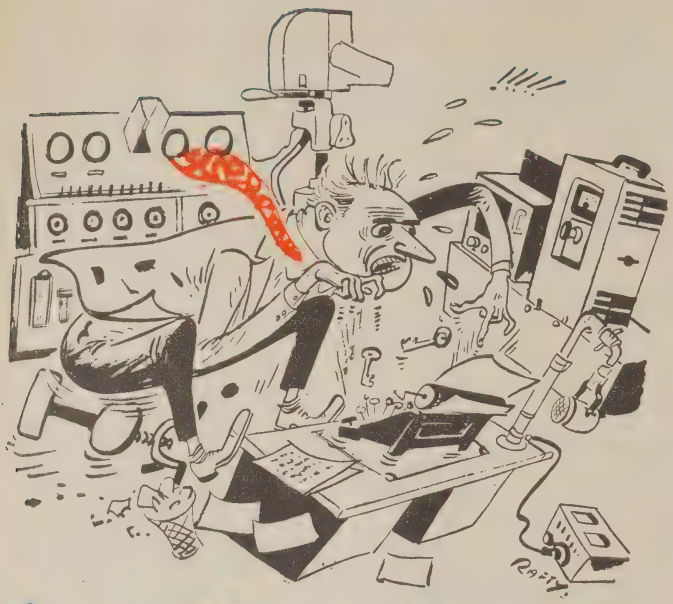

Let's Buy An Argument

When I wrote, last month, about a good arguer "coming back for more—and with more" —I hadn't counted on E.L. from the previous issue. Far from being convinced by the discourse on power supply design, our friend has come back with six solid pages by way of rejoinder and further explanation.

He enlarges on the question of losses and the calculations with which I couldn't get very far.

He denies that he "has the male bovine quadruped by its bony protuberances", which is a circumlocutory expression for "having the bull by the horns".

Rather did I get the impression that, if any manhandling was contemplated, I would be the victim of same — not the proverbial bull!

Why do I get into such scrapes? Is it the result of a nasty nature or am I "born to trouble?"

ARGUMENT IN 1927!

That isn't as silly as it sounds either. Browsing through some 1927 issues of "Wireless Weekly", I came across an argument raging in its columns about the service area of the then Sydney broadcast stations.

Readers were telling one another off in no uncertain fashion, as will be evident from the letters opposite. The same old assertions are there and the same old sarcasms that have stimulated arguments from time immemorial.

And who is W. F. Williams, "the man from Bargo"?

No, not me. Any arguments I had in those days were about looted locusts, big-ring or cockilorum — an "Australian-Rules" version of "Sheep, Sheep, Come Home".

No, W. F. Williams was my father, having arguments about radio in 1927!

And here I am in 1956, carrying on the tradition.

Time mooches on!

However, let's get back to E.L. who endorses his letter: E.L. IS STILL A HAPPY MAN!

by Neville Williams

As I said before, he writes six solid pages and invites me to print the lot.

Well, we've reprinted many letters, but six pages . . .

There'd be no room left for me! Good thing too! (Who said that?)

But enough of the banter. I won't reprint the letter in toto this month but will do my best to extract the theme of it and make the appropriate remarks.

You may remember that I was puzzled by E.L.'s references to losses in a power supply and the way he had tied them in with "calculations" involving volts, milliamps and ohms.

On the subject of these losses, E. L. quotes Audel's Radioman's Guide. It is pointed out, quite rightly, that all the energy fed from the power mains into a transformer primary is not delivered to the load circuits from the various secondary windings.

ENERGY LOST

A certain amount of energy is absorbed or lost in the process of building and collapsing the magnetic field in the iron core. A further amount is lost because of resistance in the windings, the lost energy being largely converted into heat.

It is further pointed out that the efficiency of an average transformer runs about 80 pc meaning that one must expect about 20 pc loss, when the secondary output power is compared with the primary input.

With all this I have not the slightest quarrel but I suspect that E.L. is putting the wrong construction on the term "loss", assuming that it will appear automatically as a 20 pc loss in output voltage, applied to the plates of the rectifier.

In support of this, he says that he has asked someone who has had experience in the transformer field whether manufacturers make allowance for these losses during manufacture. The answer was, and I quote:

"No allowance can be made excepting that for special transformers. Some are differently wound, making them dearer."

On the strength of this, E.L. makes his allowances. Thus a 150-volt per side transformer becomes 300 volts, less 20 pc for losses, equals 240 volts.

Nor is this all, says E.L. There are additional losses in the rectifier, which would have to be added to those from the transformer. Let's say we subtract

another 20 pc and we have 192 volts as the rectifier output.

Well now, let's pause just here and sort things out.

In the first place, E.L. is misleading himself by thinking that the useful input to the rectifier is the total voltage between the plates — in this case 300.

Closer examination of a conventional power supply circuit will reveal that the secondary is centre-tapped and that the tapping is returned to earth, either directly or through a small amount of resistance. As a result, the input voltage to either rectifier element is only half the total secondary voltage.

ONE AT A TIME

Furthermore, the action of the system is such that only one rectifier plate can conduct at a time.

Thus, if we assume a 150-volt per side transformer, then the input to one rectifier plate during a particular half-cycle will swing from zero to plus 210 (the peak value of the RMS input), then back again to zero.

During this time, the particular rectifier element will deliver a positive output pulse to the filter system.

While this is going on, the other half of the secondary and the other rectifier element is swinging negative and contributes nothing whatever to the action.

During the succeeding half-cycle, the position reverses. The second half of the system swings positive and delivers output to the filter, while the first half becomes inactive. So the action continues, one half the rectifier and one half the secondary being active at a time.

To base a calculation on the full secondary voltage is therefore a rather pointless procedure.

Only in a four-element bridge-type rectifier does the full secondary remain active at all times—but that is a different circuit altogether from the one we are discussing.

Then there's this matter of transformer efficiency and here we suspect that E.L. and his informants have been talking at cross-purposes.

An ordinary power transformer may well have an efficiency of 80 pc or thereabouts, depending on its size, the grade of lamination and the general design.

MORE COSTLY

By and large, manufacturers don't try to better this figure because, to do so would involve making the transformer larger and more costly. So a 15 to 20 pc efficiency loss can be expected in all ordinary radio type transformers.

But this doesn't mean that such transformers deliver from 15 to 20 pc less than their rated secondary voltage — not by a long straw.

If you run the meters over a power supply, which is delivering its full rated DC load current, you will probably find that the voltage on the rectifier plates is very close to the rated value.

But why?

What about the losses?

The answer is very simple.

Firstly, not all the losses in a transformer directly affect the secondary voltage. Some of them are evident mainly as heating in the core.

Secondly, those losses which do affect the secondary voltages are invariably offset by winding on an extra percentage of secondary turns.

The actual efficiency (secondary power to primary power) remains at 80 pc or thereabouts but voltage losses, with which our correspondent is concerned, are avoided.

A 150-volt per side transformer, should deliver 150 volts RMS to the plates of the rectifier at the full stated DC load current — not 150 volts less 20 pc.

Thus E.L.'s voltage calculations and his allowance for transformer losses are based alike on false premises.

Then again, the action of the rectifier and the filter system is far too complex to lump as a percentage loss, in terms of voltage.

In our September issue, we showed a specimen set of rectifier curves which are reproduced again this month for reference.

It is abundantly clear from these that the DC output voltage depends almost entirely on the DC load current and on the type of filter.

LOAD CURRENT

(As pointed out last month, the "load" current is the current actually drawn from the supply, not the rating of the

BUYING ARGUMENTS — 29 YEARS AGO

("WIRELESS WEEKLY" Friday 10th June 1927)

Fault in the receivers

Dear Sir,

I have just spent a few minutes reading "Day and Night Reception in the Country" in this week's "Wireless Weekly", and the letters are very interesting.

As two of your correspondents reside in this part of the Southern Tablelands, and both complain of wireless reception from 2BL and 2FC, I feel it is my duty to reply to their criticisms, for they have just the opposite to the kind of reception received by me.

To begin with, I have a "Colmovox Four Valve Receiver", with a single electron wire aerial 45 feet high from the ground, passing across the roof of my house from a convenient tree to a mast.

I am one of those happy men who have no complaints to make. I receive 2FC and 2BL beautifully in daylight, with increased volume and clearness at night. I also receive 3LO, 4QG and 5CL very well at night and 1YA faintly; also 2GB and 2KY (fair). Now this is what I want to say:

I am of the opinion that it is not the fault of the stations at all, but either the wireless receivers, aerials, earths or some local condition in connection with those whose reception is bad.

When I first got my receiver, and for some weeks after, I had exactly the same trouble as our friends from Avon Dam, Bowral and other places. However, when I learned how to operate my machine and did a little experimenting with my set, I was very satisfied with results.

I feel sure the trouble with all these gentlemen is local and no fault of the stations named. If otherwise, why do I and several friends of mine here receive faultless transmission?

Yours etc.

W. F. WILLIAMS

Bargo.

("WIRELESS WEEKLY" Friday, 24th June, 1927)

The man from Bargo

Dear Sir,

I have been deputed by a number of "ancient" wireless fans in the Bowral and Moss Vale district to trespass on your space to thank Mr. Williams, of Bargo, for pointing out to us so tactfully the reasons why we fail to get stations 2FC and 2BL with that clearness associated with a Colmovox Four Valve Receiver, a perfect aerial and earth, and the happy location of Bargo.

After reading Mr. Williams' letter, we are undecided as to whether we should scrap our "Super Heterodynes", Browning-Drakes, Ultradynes, Solodynes, Straight 9's, and other beginners' sets, and invest in a "Colmovox" (this is not an advt.) or invite Mr. Williams to our district to show us how to work our sets and provide information regarding the suitability of our aerials and earths.

We are never to old to learn and we feel that in this gentleman rests our only hope of salvation from the difficulties that are worrying scientists.

We would suggest that he get in touch with 2FC engineers, who are perfectly aware of the distortion menace in certain districts (also applicable to 3LO), and suggest to them how to run their show to advantage, or shift the station to Bargo, which appears to be an ideal paradise for wireless reception.

We feel that Mr. Williams is hiding his talent and modesty under the proverbial bushel (at Bargo), and would like to see more of his writings. If he would touch lightly on the Fading problems and Heaviside Layer, we feel that he could elucidate these mysteries.

We might also suggest that the educational part of his letter could be safely left in the hands of the staff of "Wireless Weekly", who we find are quite capable of transmitting knowledge acceptable to wireless enthusiasts.

Yours etc.,

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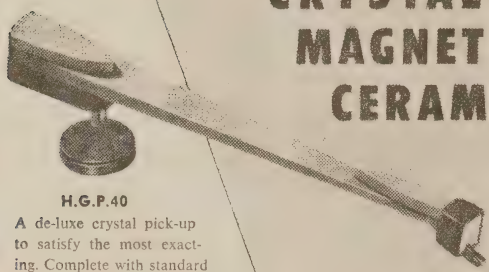

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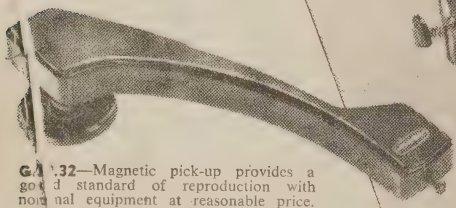

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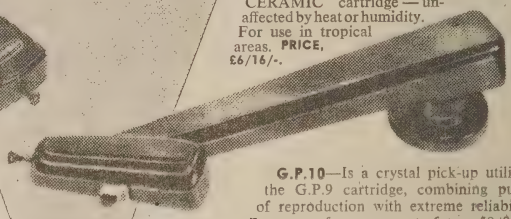

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transformer or rectifier or anything else.)

If a capacitor input filter is used, the rectifier output for 150-volts per side input will vary from about 200 volts at 5 milliamps load to 135 at 70 milliamps load.

If we remove the first filter capacitor, so that its peak-storage effect is lost, the rectifier output for the same input ranges from just over 130 volts at 5 milliamps load to about 112 at 70 milliamps.

The variation in these figures is so great that it clearly isn't possible to get anywhere near the right result by merely knocking off a certain fixed percentage for rectifier loss.

Even if we accepted E.L.'s method, which we don't, the allowance on the figures quoted would vary from 16 pc to 53 pc, according to load current and filter details.

WHY GUESS?

Surely the most sensible course, in the face of this, is not to rely on one's guessory but to use the data which valve manufacturers have gone to so much trouble to prepare.

While on this same subject, E.L. mentions half-wave rectifiers and quotes Audel's Guide as saying . . . "As the full-wave rectifier produces twice as many impulses, it is obvious that the current will be twice as great as the half-wave rectifier."

I'm not sure of the context of this paragraph in Audel's book nor why our correspondent chose to quote it. Taken as is, however, it appeals as a rather loose, general kind of statement.

It is true that a single diode element of a given design will have half the current-carrying capacity of two such diode elements.

It is also true that, under heavy load conditions, a given half-wave rectifier will deliver less output for the same input than two such rectifiers used in a full-wave circuit.

But under lightly loaded conditions, the difference between half-wave and full-wave diminishes to the point where, for example, no one bothers to use a full-wave system in the EHT supply for a CRO or a TV receiver.

Even taking the humble 6X5 curves, as illustrated, it would probably be possible to disconnect one rectifier plate, with a load current of 5 milliamps or less, and notice very little difference in the DC output to the filter.

A "NEGATIVE" LOSS

Such a situation, I imagine, would put the final quash on E.L.'s "loss method" of calculating voltages. How could he possibly account for a half-wave rectifier system operating with 150 volts total RMS input, yet delivering 200 volts DC to a lightly loaded capacitor input filter system?

Fifty volts more than was put in! A loss of minus 33 pc?

The second portion of our correspondent's letter is largely a reiteration of what he had to say in the September issue.

Having derived a figure for output voltage, by the method I have just discussed (and condemned), he proceeds to divide it by the current rating of the transformer in milliamps to derive a figure which he calls "resistance".

He apparently assumes that this is the natural resistance of the power supply—or the internal resistance to give it a better name.

Well, I can only agree that, by Ohm's Law, the process of dividing voltage by current should give an answer in terms of resistance. However, it is most important to understand these quantities before we start giving them names—or try to make use of them.

OUTPUT VOLTAGE

The voltage concerned is manifestly the DC output voltage, which is normally accepted as the voltage appearing across the input to the filter system. At this stage our correspondent may or may not agree with the accepted method of assessing it, but we won't argue about it any further.

We're talking about the DC output voltage and that's that.

Now for the figure representing current. Our correspondent simply takes the current rating of the transformer and uses that for his "calculation".

But here is the vital point: The rating of a power transformer is a more or less arbitrary figure, based on temperature rise. It doesn't exist in the transformer as a fixed electrical quantity.

Say we have a power supply using a 30-milliamp power transformer but feeding a one-valve set, drawing 5 milliamps. The only direct current we could measure in the circuit would be 5 milliamps. Nowhere would we be able to discover a 30-milliamp current.

If we had a two-valve set, the current might rise to say 10 milliamps. We could measure this quantity but, again, there wouldn't be in the circuit anywhere a current of 30 milliamps.

Now let's say we took out the 30 milliamp transformer and simply substituted one with the same voltage rating but a 40-milliamp current rating.

Again, we could measure 5 milliamps or 10 milliamps, as the case might be, but not 40 milliamps.

To put it bluntly, our correspondent is basing his calculation on a current which does not exist.

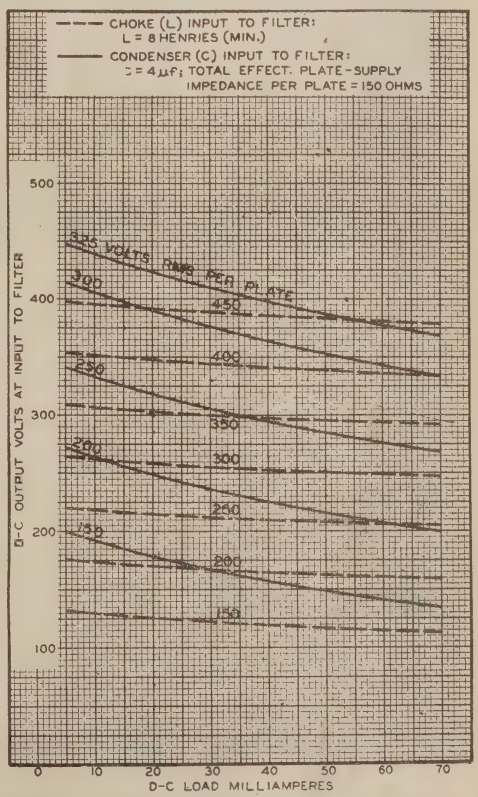
The current which really matters in working out voltage drop, &c., is the current which is actually flowing in the circuit—in other words the number of milliamps being drawn from the supply.

The importance of the 30-milliamp or the 40-milliamp rating is purely as a limit figure. It is normally meant to indicate that the load current drawn from the transformer, with a capacitor input filter, must not exceed so many milliamps—otherwise the transformer may overheat and break down.

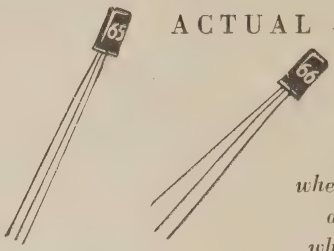
If we now apply Ohm's Law to the output voltage and the actual load current, we get a figure which represents the apparent resistance of the load circuit—a point we made in the September issue.

THIS "R" QUANTITY

It can be regarded as that amount of resistance which, if connected across the filter input terminals, would cause



These curves, similar to those published two months ago, for the 6X5 rectifier. Apart from indicating voltage output under different conditions of current drain and filter, they can be used as described to deduce the apparent internal impedance of a power supply.



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D.C.-emitter current	max. 10 mA
Collector dissipation	max. 25 mW
Junction temperature	max. 60° C.

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the same amount of current to flow. This means something.

E.L.'s calculation means nothing because he divides a voltage by a current WHICH DOES NOT EXIST in the circuit unless, perchance, the transformer is fully loaded.

E.L. may counter this by suggesting that his figure represents the internal resistance of the power supply, but even this is not correct. In fact, it cannot be so.

Think of it this way:

Transformer ratings are based on permissible temperature rise under load and this is a subject about which manufacturers have very definite and very different ideas.

It would be quite feasible for a manufacturer to produce a certain transformer and rate it at 30 milliamps. Another manufacturer may regard this rating as too conservative and produce an exactly identical transformer rated at 35 milliamps.

SAME ONLY DIFFERENT

On E.L.'s reasoning, the two transformers would have a different "resistance". Yet they would be identical.

Well, then, how would one assess the internal resistance of a power supply, assuming there was a need to do so?

The answer? By using the very same curves that serve to indicate its likely output voltage. They're used in a different way, however.

For this deduction, the significant feature is the rate of slope of the curves. At least two reference points are required of output voltage against load current.

If we take the same old 150-volt curve as an example, we find that the output is 200 volts at 5 milliamps. At 25 milliamps it is 173 volts. In other words, a change in load current of 20 milliamps has produced a change in output voltage of 27.

The equivalent internal resistance of the transformer, rectifier and filter input system is therefore 27 divided by .02 (changing the current to amps, remember) which yields a figure of 1350 ohms, over this portion of the curve.

At higher current figures, where the storage effect of the input filter capacitor contributes somewhat less to output voltage, the curve flattens off slightly and the apparent internal resistance of the supply is reduced.

If we assume a choke input filter, the curve is much flatter. From 132 volts output at 5 milliamps, the voltage drops only to 124 at 25 milliamps. This means a change of 8 volts for a current change of .02 amp, equivalent to a power supply internal resistance of 400 ohms.

This low internal resistance, which means improved voltage regulation, is consistent with the known characteristics of a choke input filter.

TYPICAL ONLY

One point I must add: All the foregoing information about voltage, current, load resistance and power supply internal resistance has been based on a set of "typical" curves. The figures quoted should be very close to the mark, but small differences will stem from winding details of the transformer, power supply frequency, rectifier characteristics and the precise rating of the input capacitor and/or choke.

The designer who uses such data, for all its detail, is generally prepared to make small adjustments to get everything right on the dot.

Perhaps it might help, E.L., just in closing, to outline the steps which one takes in designing a power supply for any given piece of equipment.

(1) Determine the required voltage on the main HT line. This will be set largely by the type of valves in the equipment and the conditions under which you want them to operate.

(2) Assess the total drain of the equipment in milliamps, by referring to typical operating data for all the valves concerned.

(3) Decide on the extent of the filtering required—a decision which will be based mainly on past experience with comparable equipment. Determine the DC resistance of the choke or chokes involved and, knowing the current which will be passing through them, work out the voltage drop in the filter system. Add this to the required HT voltage.

(4) Knowing the voltage and current required at the input to the filter, select a rectifier valve which is capable of handling both and which it is convenient to use.

(5) Using the data for this rectifier, and following the appropriate curve for capacitor or choke input filter, read off the RMS input which will be necessary to give the required DC output.

If the required figure lands on a standardised rating as, for example, 285 or 385 volts, you can consider yourself fortunate.

"JUGGLING" THINGS

If it doesn't, you may be able to get more or less voltage by choosing another type of rectifier valve. You may have to choose a choke of higher or lower DC resistance, or include a dropping resistor in the filter system.

If none of these things seems to work out, then you have to modify your ideas slightly and revamp the design to use a higher or lower HT voltage or current and try again. As a rule one is able, with a certain amount of juggling, to strike a convenient set of conditions without resorting to non-standard transformer ratings.

And that, I think, is enough of one subject for one month.

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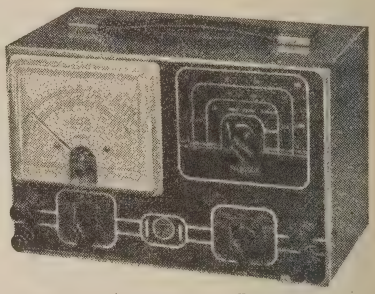
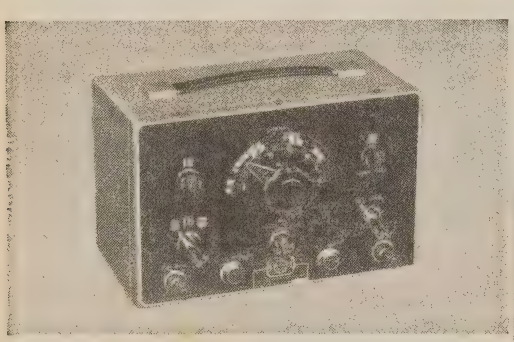
Multimeter (20,000 ohms per volt) Model TVR/MM

This new Multimeter, built to the standards that University Instruments have laid down for many years, is designed as a quick checking portable instrument for TV and radio servicemen to carry with them. A.C. voltages, D.C. voltages and output voltages may be checked in ranges of 3, 10, 30, 100, 300 and 1,000 and there are six ranges of D.C. current from 100 micro-amperes up to 10 amperes, 5 ohms ranges allowing resistances from one half ohm up to 20 megohms to be checked are obtainable with self-contained batteries, and the large W4 all polystyrene meter is employed. Light in weight and readily portable, this rugged multimeter will be handy for all types of service.



Pattern Generator, Model TVR-PG (Below)

This instrument is one of the basic instruments required for testing and adjusting TV receivers, and produces RF or IF carrier waves, amplitude modulated by video signals to produce horizontal bars, vertical bars or cross dot pattern, comprising both horizontal bars and vertical rows of dots. The carrier frequency is from 30 to 40 and 50 to 110 megacycles in fundamentals, and 100 to 220 megacycles in second harmonics. Horizontal bars from 8 to 10 are available and vertical bars from 8 to 12. On cross dot pattern the number of horizontal bars can be varied from 7 to 20 and the number of vertical rows of dots from 8 to 12 by means of controls provided. Many new features make this attractive for TV service organisations.



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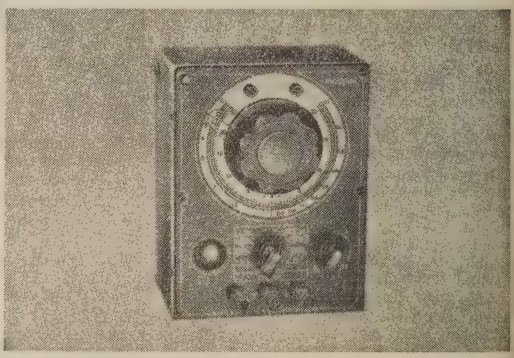
With the complex circuits in TV receivers employing many capacitors and many resistors, this special instrument provides a good standard of accuracy together with ease of handling. It covers an extensive range of resistance measurements from .1 ohm to 10 megohms and capacity measurements from 10 micro-microfarads to 10 microfarads. It is accurate and sensitive and is overload proof. A calibration system is incorporated to enable rapid checking of the apparatus of any instrument, and internal standards are adjusted to an accuracy of plus or minus 1 pc



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TRADE REVIEWS AND RELEASES

ROLA HI-FI 12Ux IS GOOD

To cater for the big demand for high quality loudspeakers, the Rola Company has released a new and improved version of the 12"1x, known as the 12Ux Hi-Fi, with a retail price of £28/19/5d including sales tax.

THE speaker has a power handling capacity of 20 watts, and a frequency response extending from 40 cycles to 14 Kc plus or minus 6 db.

The voice coil impedance has been increased to 15 ohms at 400 cycles, thus bringing it into line with what is virtually standard practice for speakers of this class.

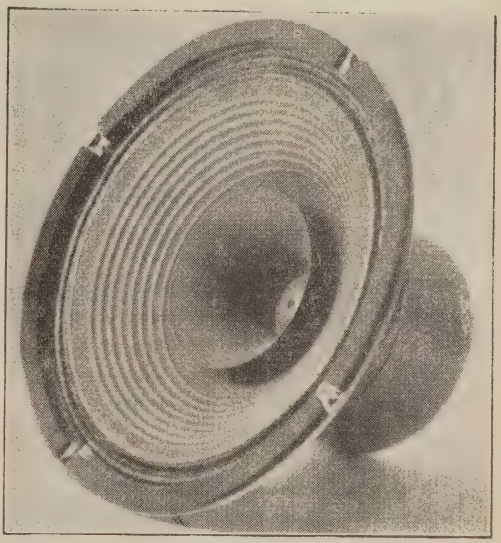
In the past, the 8 ohm voice coil of the 12Ux has sometimes made replacements awkward where 15 ohm speakers had previously been used. Moreover most high grade output transformers are wound for 15 ohms, and generally show better characteristics than do those with a larger step-down.

The new speaker has a magnet using 14,000 Gauss air gap flux density and a total of 150,000 lines.

Otherwise its specifications are similar to the earlier model.

The cone assembly has been redesigned, to have a main resonance at 45 cycles and a smoother and somewhat extended high frequency response.

Tested in the laboratory, and in home listening, this speaker proved itself to be easily the best effort of Rola to date, and a worthy contemporary of any competitor in its price class.



The Rola 12Ux Hi-Fi loudspeaker has a specially treated cone surround to reduce resonance and a second central cone for high frequency response

Sensitivity is very high. There is plenty of body in the middle register, giving bright and lively reproduction with excellent presence particularly on vocal music.

Tested in a 7.5 cubic ft vented enclosure with a six inch pipe leading from a port of 12 x 6 inches, bass response was maintained well down to the 40 cycles claimed, and the speaker handled a tidy amount of input in its lower register. Even better results can be expected from the recommended enclosure size of nine cubic ft.

The high frequency region seems free from any objectionable peaks, although there appeared to be a general rise above about 6 Kc which seems characteristic of this method of construction. The pitch of record surface noise, however, indicates that it is fairly smooth, so that this extra brilliance can be useful with a clean input signal.

According to advice from Rola, the speaker is now in full production.

NEW HIGH-GRADE TRANSFORMERS

Australia is fortunate in having some excellent output transformers available for popular amplifier circuits. On their performance figures, many compare more than favorably with those produced elsewhere in the world.

A & R have just announced a transformer kit for use with the Mullard 20 watt amplifier, all of which A & R advise have been tested and approved by Mullard for use with it.

The power transformer and choke have been designed to the specifications laid down in the Mullard manual.

The output transformer type OT921 is the standard 20-watt Ultra-linear type which was used in a 20 watt amplifier of our design, and which gave an excellent performance.

It is equally suitable for the Mullard circuit.

All items are similar in appearance, with terminal boards fitted to the power transformer and output transformers. The choke has lead outs. The covers are finished in grey Hammertone with cores in black duco.

Leaflets concerning this transformer kit are now available from all dealers.

FERGUSON OP297

A new transformer designed for the RTH 17-watt Playmaster was sent to us for test during the month. Its P-to-P impedance is 4500 ohms.

Wired into the original amplifier in our laboratory, it gave a particularly fine performance.

Noteworthy was its excellent power handling capacity. It was able to produce substantially clean sine waves at a 14 watt level between 20 cycles and 50 Kc. This feature is particularly valuable when handling the high peaks often met with in modern records.

Its main resonance occurs at 210 Kc in the form of a gradual rise to only 4 db above reference.

When compensated with 100 pf across the feedback resistor, to give a virtually perfect square wave at 5 Kc, the response was only 1 db down at 100 Kc and 3 db down at 200 Kc, using the 15 ohm output connection.

This performance is far beyond that required for the highest grade reproduction.

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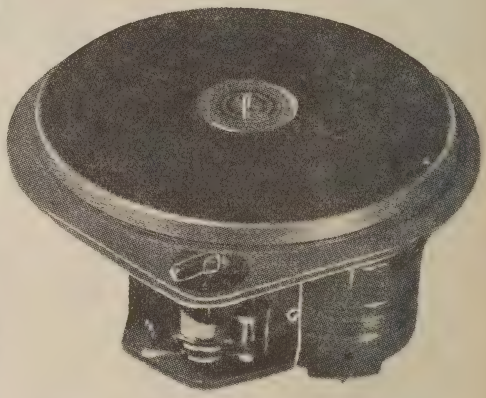

TYPE 12A TRANSCRIPTION TURNTABLE

THIS IS WHAT ONE DISCRIMINATING MUSIC LOVER SAYS ABOUT THE TYPE 12A

Mosman, N.S.W.
2nd March, 1956.

The Managing Director,
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Almost a year ago I installed a three-speed Commonwealth Electronics turntable, type 12A, and so excellent have I found it that I feel I should tell you about it. Its solid frame is a most effective check against motor vibration, the heavy and beautifully machined turntable eliminates wow, flutter and rumble, and the motor which runs with almost ghostly silence is a splendid example of precision. Also the finish of the article is in good taste and enchances the appearance of the equipment with which it is associated. I believe I have found the perfect turntable.

Yours faithfully,
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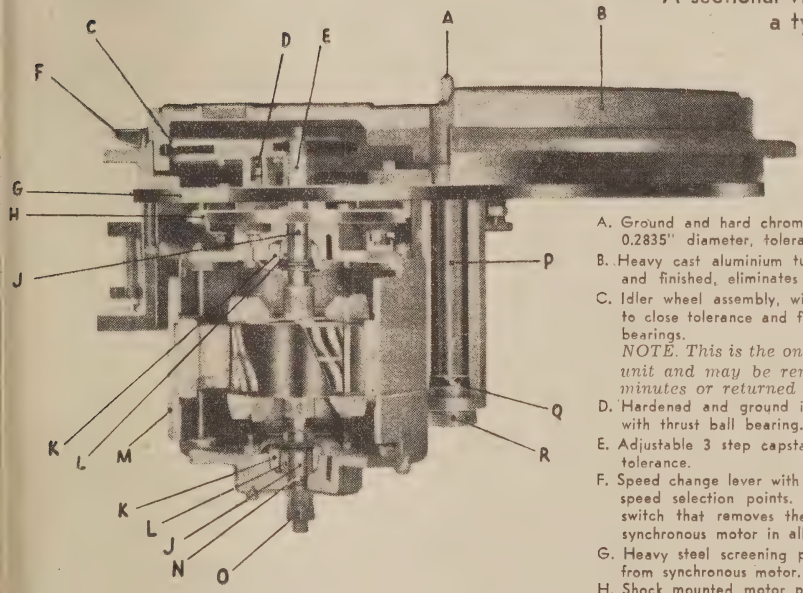
A sectional view of
a type 12A Turntable



A. Ground and hard chromed record centre spindle, 0.2835" diameter, tolerance + or — 0.0005".

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NOTE. This is the only wearing part in the unit and may be renewed in a matter of minutes or returned for grinding.

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E. Adjustable 3 step capstan manufactured to close tolerance.

F. Speed change lever with neutral positions between speed selection points. Also operates a micro-switch that removes the mains supply from the synchronous motor in all neutral positions.

G. Heavy steel screening plate reduces hum pickup from synchronous motor.

H. Shock mounted motor plate reduces rumble to a negligible value.

J. Precision nickel steel motor spindle hardened, ground and diamond lapped to 3 micron surface finish. Provides life-long service and silent running.

K. Generous size oil reservoir pads.

L. Self-aligning sintered bronze bearings.

M. Heavy duty 4 pole synchronous motor with dynamically balanced rotor, gives adequate torque with low temperature rise for continuous operation.

N. Motor spindle thrust ball.

O. Adjustable thrust spindle fitted with sintered bronze bearing pad.

P. Large diameter turntable spindle, ground and hard chrome plated, runs in two sintered bronze bearings

Q. Turntable thrust ball.

R. Adjustable thrust block.

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Just landed another shipment of this popular line. This unit combines a 4½ watt amplifier with two inputs, one for the built-in 3-speed Philips record player and one for a crystal microphone, each input with its own volume control.

Also two outputs, one connected to the built-in 5-inch speaker and one for a separate extension speaker. The case is finished in two-tone leatherette. Ideal for parties, dances or for playing records in the home. Worth £36/15/-.

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Extras if required—Crystal Microphone—Worth £3/19/6. **Reduced to 39/6.**

6-inch extension Speaker in leatherette-covered box. Worth £3/4/-. **Reduced to 49/6.**

Also available same jobs as above, without the microphone input and external speaker connections, but with tone control. Ideal for reproduction of all types of records. **Price £19/19/-.**

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A READER BUILT IT!

Gadgets and circuits which we have not actually tried out, but published for the general interest of beginners and experimenters.

COMPACT, LOW COST HORN-TYPE SPEAKER ENCLOSURE

In the face of all the discussion recently in regard to loudspeaker enclosures, it is interesting to consider the viewpoint of a reader in Lane Cove, NSW, who has sought to combine reasonable fidelity with economy both in first cost and room space.

THE reader concerned is Mr. G. A. Kaye, of 78 Phoenix St., Lane Cove, NSW.

Mr. Kaye contends that, although some of the Hi-Fi equipment available is capable of very high quality, the cost is out of proportion to the results achieved. Further, that highly satisfactory results can be obtained for a much more modest outlay.

In line with this, he determined that he would not spend more than £10 to £15 on a speaker and would construct an enclosure for it which could be built simply and cheaply and not take up too much space in the room.

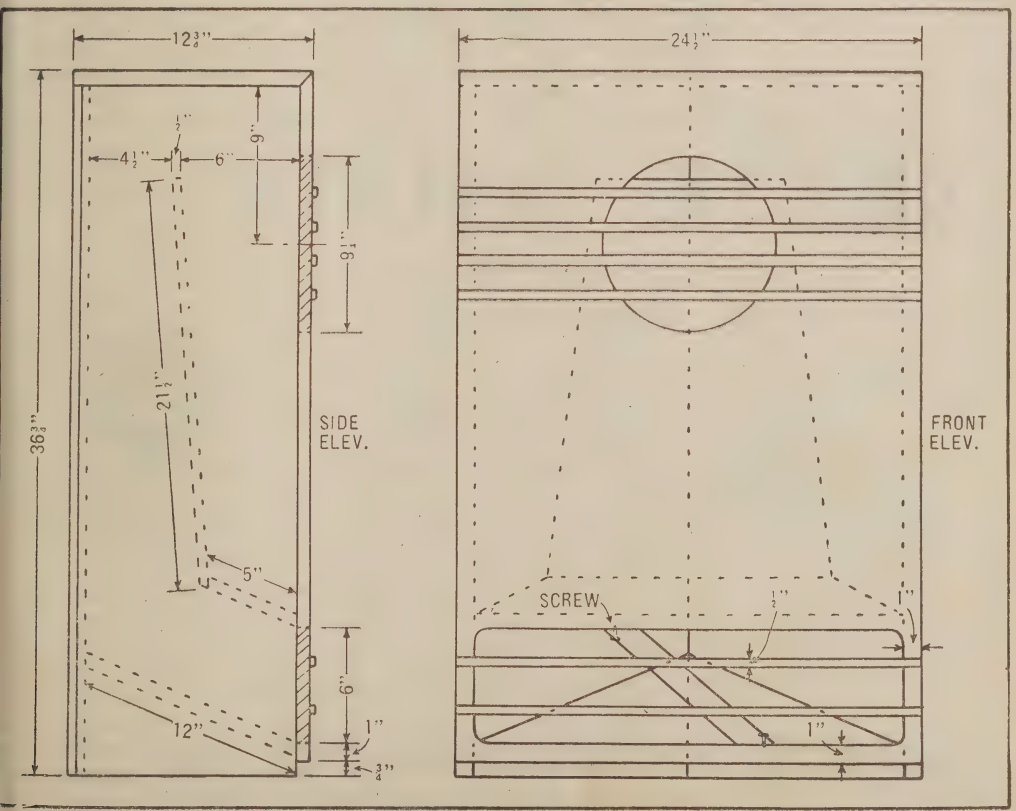
Having since read our articles on enclosures generally, he has written again to point out that his design has a purely empirical basis and may be the result as much as anything of "a lucky fluke."

None the less, he is very happy with it.

Mr. Kaye says that he selected a Stenorian speaker type HF1012, which has power handling capacity rating of 10 watts and a frequency rating of from 30 to 14,000 cps. He suggest that this compares more than favorably with most larger speakers in the same price bracket.

And from here we quote Mr. Kaye's letter:

"The enclosure was a problem as the room in which the speaker was to be used was not large. All the published designs which could be traced were too bulky and most were critical of the speaker characteristics.



Showing the front and side views of the enclosure. Its triangular shape allows it to stand in a corner while taking up the least possible floor space.

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Impedance .. .. 15 ohms	Force mass ratio .. .. 4x10 7 dynes/gm.	Weight 8lb

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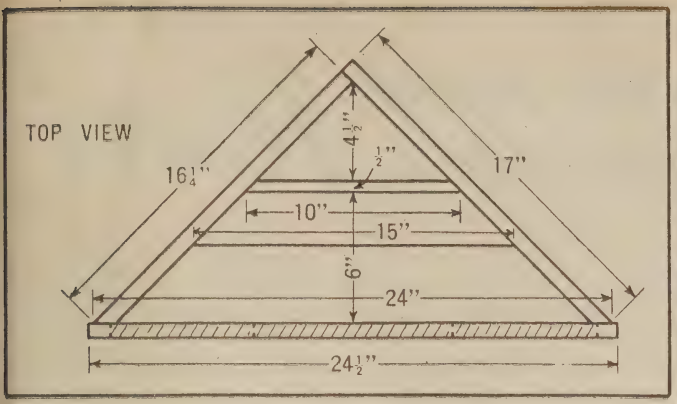


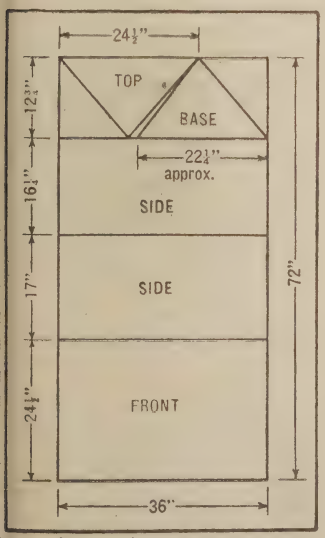
A plain view of the enclosure. Note that the front face measures only 24 inches across.

"However, with the Mullard 5-10 amplifier book was supplied a leaflet giving details of a horn type enclosure not critical of the speaker characteristics. It was much too large for the writer's requirements, but it was felt that a corner cabinet could perhaps be constructed making use of the same principle and yet occupying very little floor space.

DETAILS OF HORN

"The design described was the result. After living with it for about four months I feel very happy with it and I can recommend it to anyone requiring an unobtrusive enclosure at moderate cost. It could easily be modified to take anything from an 8in to 12in speaker.

"A single sheet of ¾in plywood 6ft x 3ft and a piece of ½in plywood 15in x 21½in is all the wood required, except for protective beading and a small piece of scrap to support the vent cloth.



Most of the timber for the enclosure can be cut from a single sheet of 6' x 3' plywood—an important economy feature.

"The diagram showing how the ¾in plywood was cut up leaves about 1½in allowing a margin for planing down. The front need only be 2ft wide but an extra ½in makes sure that the sides are fully concealed.

"The 5in floor of the speaker cavity is cut from the piece removed to form the lower vent so that the latter cut-out should be carefully done. In case of an accident a further small piece of ½in plywood could be substituted.

"Careful planing of angles will ensure a tight fit, as owing to the triangulated design the structure is very rigid without need for a frame. The whole was screwed together, the top being removable to get at the speaker.

USE OF BEADING

"To improve the appearance and to protect the speaker cloth, ½in beading was fixed as shown in the diagrams. The cabinet was left in its natural state and the beading was stained to give a contrast. Instead of french polish the wood was treated with clear plastic as this is reputed to give a durable finish which does not easily mark.

"Burlap was used to cover the vents, being fitted flush with the front of the cabinet and held in place by strip aluminium nailed to the wood. The front compartment was lined with carpet underfelt.

"The design could probably be further simplified by making the bases of both compartments horizontal without appreciable difference to the results."

Australian TV standards

(Continued from Page 79)

time of, say, .004H and returning to the black level in a similar time would be satisfactory.

However, in the presence of a noise pulse in antiphase, such a short pulse could be completely wiped out and synchronisation lost. With a pulse width of .045H there is always likely to be a component which will pass through the differentiator and trigger the line oscillator, even if a fraction of a microsecond later than normal, and, therefore, sync. will be maintained reasonably well.

As the normal line pulse must be twice the width of an equalising pulse, the minimum duration time is .09H as specified in the standards.

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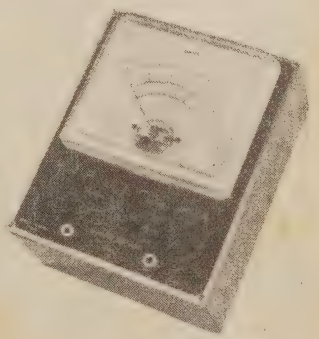

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Here's your answer, Tom!

Answer Tom article this month takes a novel form. It is based on a report, submitted by a reader in the Newcastle district, of his experiences while carrying out experiments on various pieces of radio gear. We have selected excerpts of general interest, with our comments, on these.

"Recently I have had trouble with a modified 'Ham' set for beginners. The modifications consisted of running a half-wave connected 80 straight off the 240 volt mains, for the high tension requirements . . . etc."

We have made comments on this type of circuit on various occasions, but too much cannot be said about the dangers of it.

Rectification of the mains voltage directly, without the use of a transformer may very easily make your set lethal. This is all the more true as you intend to experiment with it.

Incorrect orientation of the incoming AC leads could make the chassis or "earth" wiring alive with respect to earth and we shudder to think of the many possible ways of electrocuting yourself as a result.

We don't like the arrangement, Tom, and you would be well advised to put in a transformer, which will isolate the receiver circuits from the actual power mains wiring.

★ ★ ★

"After experimenting with the plate load of the first valve . . . and with more fiddling around, the output 6SH7 began to heat excessively and finally fizzled out completely."

We cannot point out too strongly, Tom, the hazards of "fiddling around", unless you have some idea of what you are doing and why you are doing it.

Not knowing the values of the components used in your circuit, we can only assume that your high tension is around 250 volts, allowing for a current drain of about 20 mA and some voltage drop across the filter.

Two posible causes for the 6SH7 to overheat and become inoperative, spring to mind — excessive screen voltage, incorrect bias or both.

Referring to valve data sheets, we find that the 6SH7 with 250 volts on the plate, should have a screen voltage of 150 and a grid bias of —1.

Under these conditions the plate current should be 10.8 mA and the screen current 4.1 mA. Given these figures, it is possible to calculate the values of bias resistor and screen dropping resistor.

The current flowing through the cathode is the sum of the screen and plate currents. Applying Ohm's Law the required value of bias resistor is found to be about 70 ohms. Likewise the value of screen dropping resistor is found to be approximately 4000 ohms.

With resistors in circuit of these values (or larger) the valve would be quite safe. But shorting out the bias or running the screen at a higher potential would increase the current through the valve quite markedly.

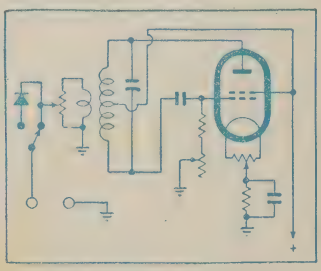
Operating it in this fashion for a length of time could cause it to lose emission, go gassy or develop mechanical faults.

★ ★ ★

"A feature of this set which puzzles me, is the tuning circuit. To position the stations correctly on the dial, a standard commercial coil had to be altered . . . etc. This had the effect of pushing the high frequency end of the band off the dial. Adding turns to the coil made the low frequency stations come in where the high frequency stations should have been."

This looks like a perfect example of what we have just been talking about—"fiddling" on a rather drastic scale. The last thing you should have done, Tom, was to wreck a perfectly good commercial coil.

A point that most beginners overlook Tom, is that tracking with dial markings



The Hartley oscillator referred to in the test.

is a function not so much of the coils, but of the variable capacitor.

The shape of the plates is a determining factor as to whether a given capacitor will track with a given dial. Altering the value of the inductance will affect the tuning range more than the relative position of stations.

As will be obvious from your experience, Tom, increasing the inductance of the coil and retaining a given value of maximum and minimum capacity, will make the circuit tune to a very much lower frequency, with a sacrifice at the high frequency end of the band.

Conversely, decreasing the inductance will allow you to tune to a very much higher frequency, with the loss of the low frequency end of the band.

We suggest, Tom, that you try to obtain a dial glass to match your variable capacitor, or vice versa, and use an unmodified coil. This should then give correct coverage of the broadcast band. So much for the receiver.

Enclosed with Tom's letter were two circuits, a modified Wheatstone bridge, for resistance, capacitance and inductance measurements, and a Hartley oscillator which is reproduced herewith.

We cannot pick any faults in the bridge circuit, Tom, except that it is advisable to have a stage of amplification so as to increase sensitivity and accuracy, and allow the use of a low voltage signal source.

A second point is that the use of a filter choke as an inductance standard is not very satisfactory.

★ ★ ★

"The Hartley oscillator is intended as a companion instrument for the bridge, with provision to demodulate the RF output and use the resultant audio signal as the excitation source for the bridge."

There is a point you may have overlooked, Tom. The RF output will not be modulated, unless you are relying on a squegging action, which although not implied may be assumed. If an external source of audio signal is required for modulation purposes, it is pointless to demodulate the RF output in order to obtain the same audio signal.

Now for a few straightforward questions from Tom, commencing with two on sound recording and reproduction.

★ ★ ★

Why is it that low disc speeds are chosen as a medium for high quality sound? With high speeds there is more distance covered per unit time and per musical vibration, and hence, more room for detail. This is recognised in tape recording, as slow speeds are used to obtain long recording time at the expense of quality.

What you say, Tom, is perfectly true but you have neglected one importan

int, namely that such records are icrogrooves".
Scaling down groove width makes ssible a reduction in record speed thout loss of quality. Slower record eeds and finer groove spacing allow very much longer playing time, which quite important for reproducing long sical compositions.
Considered together, these features ke the slow speeds a logical choice high quality sound recording, parularly for classical works.
In the case of tape recording, Tom, odern high coercivity tapes and a crease of the gap width through odern manufacturing processes, allow high standard of quality to be ieved with a tape speed of 7½in per ond.
Higher speeds are only used these ys in circumstances where cost of tape d wear on the heads is of minor sigicance.

★ ★ ★

What is the basic difference between a standard and long-playing pickup? Is it only the stylus radius?

No, the stylus tip is only part of the ry, Tom.
Because the stylus is of smaller diter, the weight of the pickup has be reduced considerably to avoid nage to the record.
Reduced weight means a greater dency for the stylus to jump out of fine grooves on heavily modulated ssages. This demands that the mass d stiffness of the moving parts in pickup be kept to a minimum.
By the time you allow for similar inements to the design of the bears which carry the arm, Tom, you can that the changes are quite extensive.
As a matter of fact, manufacturers m largely to have excelled themves in producing pickups which satisfy exacting requirements of the LP c and give better performance into bargain.

★ ★ ★

Are the frequency channels of American television receivers suitable for Australian frequencies?

t is possible Tom, that some of the erican channels may coincide with channels allocated in Australia. How-r, if this query was prompted by an ention of using an American circuit, shall have to disappoint you because two systems differ in other respects. anges would have to be made to apt an American circuit or receiver local conditions.
An important difference between the erican and Australian systems is the nber of scanning lines and picture mes in use. The American system s a scanning rate of 525 lines to our lines and 60 frames per second to 50.
A further point is that the separation ween sound and picture carriers is Mc for the American system against Mc locally. This affects the video dwidth and also the design of the rcarrier sound channel.

★ ★ ★

Would it not be possible to make television set using for example 6SH7 and a 6V6 for the audio ection? With a 100 Kw transmitter urely this would be sufficient?

A fact that you seem to have forgotten, Tom, is that the sound carrier of a television broadcast is frequency modulated. A ratio detector or frequency discriminator would be required to demodulate the sound signal.
A further point is that a regenerative receiver using such valves would not be practical for the frequencies on which television signals are radiated. A super-regenerative circuit might work but would cause bad interference in neighboring receivers.
The proximity of sound and picture signals would present a further problem since a simple receiv.. may not be able to separate one from the other.
And now for a few questions from other readers, to end this article.

★ ★ ★

What essential difference is there between the terms Oscillogram, Oscillograph and Oscilloscope?

These terms certainly do get mixed up in their usage.
Actually, an oscillograph and an oscilloscope could be one and the same instrument. Both are used in the investigation of waveforms of alternating voltages. The wave forms are usually traced on the screen of a cathode ray tube.
The term oscillograph is applicable when the instrument is used to produce a permanent record of the wave form, usually by photographic methods. The term oscilloscope applies when the instrument is used for direct observation only.
An oscillogram is a printed record of the wave form, as shown by the trace on an oscillograph screen.

★ ★ ★

What is meant by the term Edison Effect?

Early types of electric lamps used a carbon filament and it was noticed that, after a time, the bulb blackened on the inside of the glass.
Edison investigated this effect and proved that, by putting a small conductive plate in the lamp and making connection to it, charged particles were emitted from the filament. He also proved that the path between the filament and plate gave conduction in one direction only.
It is this emission of charged particles from a heated filament which makes possible the conduction of electricity between the filament and plate in a radio valve. The effect was named after Edison, who was the first to investigate it.

★ ★ ★

What is a pi-coupler?

The most elementary form of "pic" coupler that we know of is a common table fork.
But jokes aside, Tom, the real pi-coupler is a type of tuned circuit used to couple the output stage of a transmitter to an aerial. Its main feature is that it allows any length of aerial wire to be used.
The pi-coupler tunes the whole system to resonance, ensuring proper operation of the transmitter output stage and good radiation at the same time.

What is an auto transformer?

An auto transformer, Tom, is a trans-

(Continued on Page 115)

METAL UTILITY CABINETS

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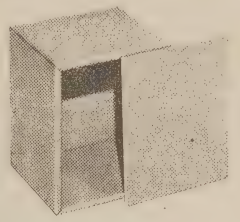

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SPEAKER BAFFLING PROBLEMS

The main reaction to our recent articles on loudspeaker enclosures has been from readers who have bought speakers with cone systems having a low bass resonant frequency. How can such speakers be adequately baffled? Is a vented enclosure practical — or even a good choice?

PART THREE

CONSIDERATION of the design data and the curves published in the last two issues will indicate the nature of the problem.

For many speakers having a cone resonance of 60 cps or above, there is no special ambiguity about the design data.

The resonance is prominent enough to benefit by the selective loading of a vented enclosure and, depending on details, the enclosure is likely to work out at between 5 and 6 cubic feet, with a throat length of up to about 6in—both quite practical figures.

The data can be applied and used more or less automatically.

Experience has shown that such speaker/enclosure combinations reproduce frequencies efficiently to somewhat below the nominal resonance of the speaker cone, the ultimate smoothness depending on adjustment of resonance and damping, as outlined in the two previous issues.

EASY TO MAKE

In general, the constructors are happy with the result, because the cabinet work is straightforward and the reproduction much improved over more elementary methods of speaker baffling.

Of late, however, there has been a tendency for higher quality speakers to be designed with lower figures of cone system resonance, mainly by the use of cloth, chamois leather or specially treated cone surround.

The object of such treatment is to shift the resonance to the very extreme of the musical range so that there will be less chance of the reproduction being colored thereby.

The practice is now so prevalent that virtually every modern high-grade speaker, suitable for the best amplifiers, falls into this low-resonance category. This applies, whether it is a full-range type or a "woofer" intended for bass reproduction only.

SPEAKER CONSTRUCTION

In general, the objective is a worthy one but it has far-reaching implications, both as regards the basic design of the speaker and the methods of baffling it.

As far as the speaker is concerned, a lower frequency of cone resonance is normally achieved by using a more compliant cone suspension. An immediate effect of the change is to permit increased cone excursion when the voice coil is excited at very low frequencies.

Unless the pole faces and voice coil are of generous proportions, the extra cone travel will carry the voice coil toward the limits of the magnetic field. Non-linearity must result when this occurs, with harmonic distortion and intermodulation.

Lengthening the voice coil or the gap to anticipate the danger is likely to prejudice sensitivity or electrical cone damping unless, at the same time, the size or efficiency of the magnetic circuit is correspondingly increased.

Out of this emerges a very practical relationship between cone resonance, power handling capacity, distortion content, mechanical reliability, sensitivity, magnet size—and cost!

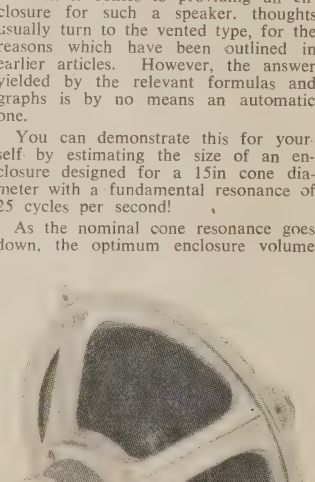
While these remarks are incidental to the main thought of speaker baffling, they do at least indicate that there is more to lowering cone resonance than merely modifying the surround.

VENTED ENCLOSURE

When it comes to providing an enclosure for such a speaker, thoughts usually turn to the vented type, for the reasons which have been outlined in earlier articles. However, the answer yielded by the relevant formulas and graphs is by no means an automatic one.

You can demonstrate this for yourself by estimating the size of an enclosure designed for a 15in cone diameter with a fundamental resonance of 25 cycles per second!

As the nominal cone resonance goes down, the optimum enclosure volume and/or throat length required to match it goes up quite alarmingly and begins to assume impractical proportions.



This 15-inch woofer has a resonance—barely detectable acoustically, of 25 cycles. It is not practical to build a vented enclosure to match this figure, nor is the resonance sufficiently prominent to justify such a course.

But that is not all.

The mechanics of speaker design are such that treatments which lower the FREQUENCY of cone resonance frequently tend to lower its AMPLITUDE at the same time.

Thus, with a speaker having a reso nance at say 70cps, it is usually n difficult to hear the rise in output a an oscillator is run over this regio However, with speakers having a reso nance nearer 40 cps (or lower) the reso nant point is often very difficult, if n impossible, to discover by a simp listening test, when the speaker is fe from an ordinary low impedance ampl fier.

NO RESONANCE?

As far as acoustic output is concerne it is not far from the truth to sugge that such speakers have no fundament resonance at all.

Thus two basic problems arise whe ordinary vented enclosure practice applied to such speakers:

(1) The dimensions of the enclosur based on cone diameter and cone reso nance, become quite unwieldy.

(2) The very basis of the approac may be challenged because it involv a quantity—cone resonance—which h virtually ceased to have any practic significance.

If, in fact, the speaker can be co sidered as an essentially flat transduce then it cannot add to or take away fro the characteristics of an associated e closure.

The acoustic output will depe mainly on the characteristics of th said enclosure; where it introduc special modes of operation, where reinforces front radiation, where it los coupling—and the degree, by reason damping, to which it does all the things.

The question of complementing co resonance with enclosure resona ceases to have any significance.

OF DOUBTFUL VALUE

Does this abrogate the principle the vented enclosure, which has be the subject of so much research a calculation?

Some may say "yes", for obvio reasons.

Some may say "no"—it is merely extension of the concept to the po where the reactive quantities in speak and enclosure have been obliterated "R".

But whatever the theoretical positi actually involved—and it isn't simple

the conclusion is much the same. This is simply that the best modern speakers have resonance figures so low in position and amplitude, that the original vented enclosure concept is not worth pursuing.

While this statement may at one time be interesting, provocative and vague, it certainly calls for closer examination of the position.

Under what conditions does the vented enclosure principle become "not worth pursuing"?

Should it ever have been pursued at all?

By and large, speakers having a cone resonance of say 60 cps and above conform to a pattern which fits in with the vented enclosure concept. Their performance is likely to benefit from the selective loading of the enclosure on the cone.

There is no special problem here.

The resonance, which might otherwise be a prominent and limiting feature of the speaker's performance, is lowered and broadened under the influence of the enclosure, according to the accepted theory.

"TRANSITION" SPEAKERS

Speakers having a cone resonance in the 50-cycle region might be regarded as having "transitional" characteristics (for the present discussion) because their resonance is much lower in position and amplitude than the class of speaker just mentioned.

The case for selective loading on the cone is, therefore, much weaker, yet the fact remains that the speaker still has to be provided with some kind of baffle system.

Horns, labyrinths and flat baffles have their known properties and limitations. Completely sealed boxes—the so-called "infinite" baffle needs to be treated with caution with such speakers, in case the air loading on the cone should boost the resonance to objectionable proportions.

The vented enclosure system must, therefore, still merit consideration with such speakers, even though it is assumed to be heavily damped and not necessarily exactly resonant with the speaker.

According to individual circumstances, such an enclosure could help smooth as much of the resonance as remains; it could alternatively be tuned below the speaker resonance; in either case, the phase reversing characteristics will be operative to give some reinforcement below 50 cps.

HOW LARGE?

From this stems our statement last month that the enclosure, under such conditions, can often be considered as "a large padded box, which retains sufficient of its phase-reversing properties to assist the speaker at very low frequencies".

If such be the case, how large should this "large padded box, etc.," be?

Some indication of size is obviously required.

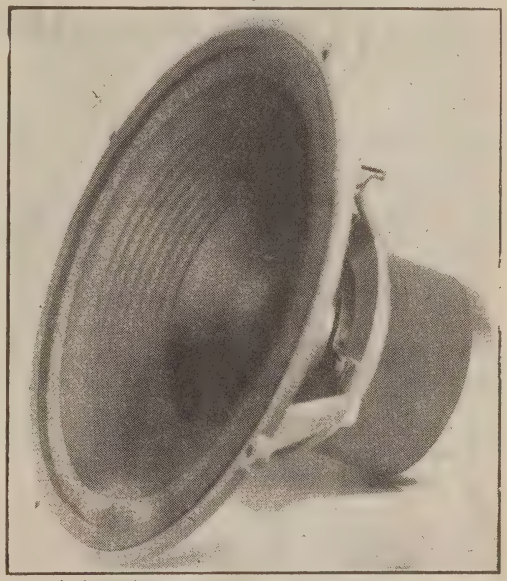
There would be no point in purchasing a low-resonance speaker, only to mount it in an enclosure which itself had a high resonance. At the very least, the enclosure resonance should equal that of the speaker or be lower again in frequency.

If this assumption is permissible, then it is logical to use the enclosure design data, if only to ensure that the enclosure resonance is low enough.

Or again, as we suggested last month, the enclosure volume figure can be treated as a minimum.

So much for what we choose to call "transitional" speakers—those with a barely perceptible resonance at about 50cps.

For such speakers it is possible to follow the design curves, with the aforementioned reservations, because figures for enclosure volume and throat length are not prohibitive.



Representing a high quality, wide range speaker, with a small resonance of 40 cycles, this speaker would require a heavily damped enclosure of at least 9 cubic feet, but would give a smoother bass output in an "infinite baffle" of the same size, and with little change in output level. Note the cloth surround, large magnet, and free spider suspension.

However, once the nominal speaker resonance gets below 50cps, the data rapidly becomes unwieldy. The would-be constructor is faced with the alternative of providing a huge enclosure, or of using one that, by reason of its limited size, will resonate within the range of his "non-resonant" speaker.

Hence the readers' queries which we referred to at the beginning of the article.

Faced with these queries, and a few of our own, we have spent some time in the interim experimenting with a 15in 25-cycle "woofer', running over the range with an oscillator and with the speaker variously baffled.

The tests were carried out in an ordinary large listening room, which was at the one time a limitation and an advantage.

It was a limitation, because standing-wave effects in the room led to some confusion about sharp dips and peaks in the acoustic output.

EFFECT OF THE ROOM

It was an advantage, because the presence of these peaks and dips acted as a constant reminder that the room is a very active participant in propagating acoustic energy; that preoccupation with minor effects was quite futile, because these effects varied with the listening position.

As a matter of further interest, we made quite a few checks on voice coil impedance during the tests, using a meter and isolating resistor, as mentioned last month.

While the meter readings are significant under specific conditions of cone or enclosure resonance, they certainly cannot be treated as a general indication of acoustic output at other frequencies or under other conditions.

Many variations in acoustic output do not relate at all to impedance unless, perchance, one possesses the perspicacity of the proverbial "Japanese Lawyer".

By and large, lacking an anechoic test chamber and a calibrated microphone set-up, one has to rely on personal observation.

From all these tests, however, certain points emerged as fairly obvious.

In the first place few enthusiasts can countenance an enclosure with a useful internal volume of more than about 7 cubic feet. If operated with a vent of normal area, such an enclosure cannot be resonated to a figure comparable with many modern speaker cones.

It must inject its own characteristics into the range, thus largely invalidating the effort and money spent in producing and acquiring a low-resonance high quality speaker.

SMOOTHER OUTPUT

Listening tests, both with the oscillator and on music, confirmed this expectation with just such an enclosure.

There was no lack of bass—and very good bass by most reckoning — but "lumpy" enough and "colored" enough to fall short of the highest quality standards.

Restricting the vent, varying the throat length, etc., modified the effects but did not eliminate them.

Then we blocked up the vent

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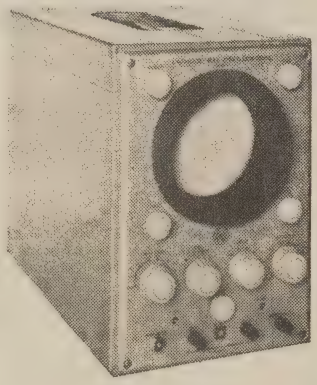

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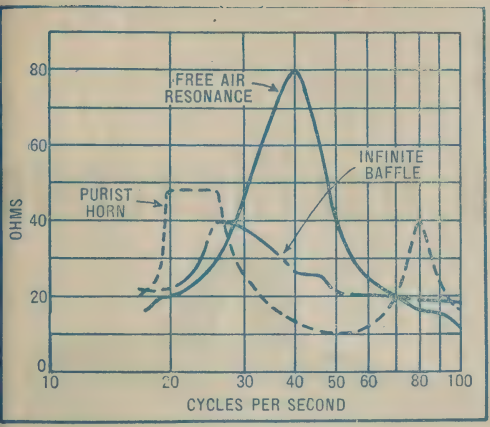

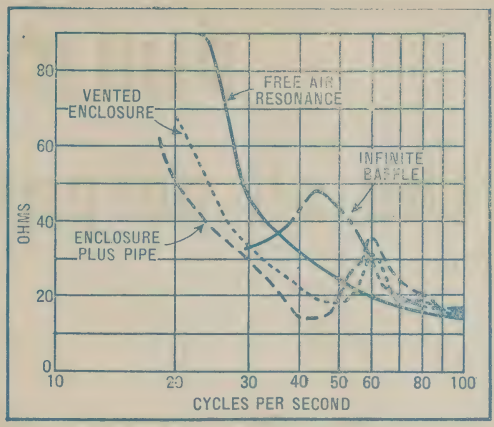

These curves show variation in 15 ohm speaker voice coil impedance with different methods of mounting, using an isolating resistor in series and driven from a constant voltage source. They do not indicate acoustic output, but they do show the effect of the enclosures on the speaker's behavior. In both cases, the "infinite baffle shows a freedom from sudden changes in the useful region. Factors which play a part in the amplitude and nature of the peaks and troughs include room position, enclosure materials and cabinet damping, all which are subject to wide variation in practice. Two different speakers were used.

ltogether, turning the 7 cubic feet enlosure into a 7 cubic feet "infinite" affle.

The immediate effect was to smooth ut the response, eliminating many of ie minor peaks and dips and also the ıajor rise due to cabinet resonance.

The system appeared to be quite nooth to about 45 cps, tapering gradully away as air loading on the back f the cone restricted its movement. But ven though there was some loss of fficiency below 45 cps, the output at 0 cps was actually higher with the ent closed than open—because, preımably, the enclosure was too small to perate anyway at this frequency.

If sealing the enclosure did lift the peaker's cone resonance, it was still oo low and too well damped to show p.

After a few evenings' listening, we ound ourselves enjoying the reproducion best with the control unit set for ne degree of bass boost to offset the radual taper below 50 cps.

With a generously proportioned peaker and plenty of reserve power vailable from the amplifier, this is of ıo consequence when compared with he added smoothness of the system.

PLENTY OF BASS

The absence of "lumpiness" in the ass. and the lack of coloration which ent with it, soon convinced us that his more even response, coupled with leaner transients, was far more acceptble over long periods of listening.

Nor was there any reason to complain hat the bass response was inadequate. lespite the apparent roll-off which was o be expected.

Independent tests with a 40-cycle peaker yielded similar finding and avored a sealed enclosure.

With a 45-cycle 12in speaker, the nerits of the sealed box were not quite o clear cut. At some frequencies adiation was better with the vent open and the final result on listening more debatable.

The inference to be drawn from all this is obvious enough. It is not only impractical but unwise to operate high-quality low-resonance speakers in a vented enclosure designed along conventional lines.

A smoother response will generally be had from a sealed, padded enclosure. However, this enclosure should have an effective internal volume of at least 6 cubic feet, to avoid too restrictive air loading on the rear of the cone.

Fortunately, it is a simple matter to block the vent in an existing enclosure and try the effect for yourself.

How can we summarise the foregoing in a manner for the man who is looking for guidance? We suggest the following:

(1) In speakers with a fundamental resonance of 60cps or above, the basic procedure for vented enclosures is valid, because such speakers do generally give extra output at their resonant frequencies. Selective loading on the cone will improve this.

The less noticeable the resonance, the more profitable it will be to "damp" the vent with a cloth covering.

(2) For speakers with a resonance in the 45-60 region, the vented enclosure design can be followed as a general indication of size. The desirability for heavy damping can be assumed. In certain cases, overall results may be improved by restricting or blocking the vent, particularly where the cone resonance is nearer 45cps.

(3) For speakers with resonances below 45cps, vented enclosures are not required to offset the cone's behavior at resonance because, in virtually every case, there is no rise in acoustic output from the speaker, when fed from a modern amplifier.

Unless a very big enclosure is possible, from which a useful phase-reversal reinforcement is possible at very low frequencies, it is best to use a completely sealed enclosure of not less than 7 cubic feet.

The enclosure must be of extremely solid construction and heavily padded inside to prevent the possible generation of standing waves and harmonic modes.

And, finally, is this the last word on the subject?

It would be most surprising if it were. What we have said indicates a changing approach brought on largely by changing speaker design.

Engineers are beginning to look at the vented enclosure not so much as a selective loading device but as a phase-reversing system much akin in some characteristics to a labyrinth or even a folded horn.

It seems inevitable that enclosure designs will begin to emerge which ignore completely the nominal cone resonance. It has become possible to do that.

The design will be based on the size of the cone and where it needs assistance to maintain efficiency. The compromise will be between the size of enclosure which can be tolerated, the degree of reinforcement from vents of varying size and the frequency at which such reinforcement is available.

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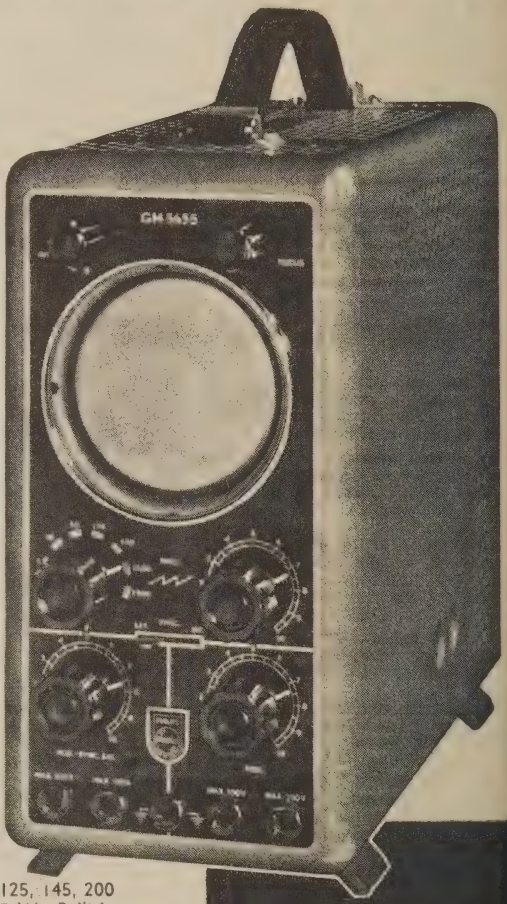

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The 1956 Karset

(Continued from page 39)

an article to the whole subject of vibrators. However, in the meantime, a brief summary of the situation may be helpful.

Theoretically, the buffer in any vibrator system should be across the primary wiring. Unfortunately, the amount of capacitance required for such a low impedance circuit would be too large and too expensive, so a much smaller value is placed across the secondary and effectively "reflected" into the primary as the required larger value.

This is satisfactory for all 6-volt systems and most 12-volt systems, but has to be modified for some 12-volt and all higher voltage systems.

Due to leakage inductance in the transformers the buffer is not as intimately coupled to the primary as is necessary and even a slight tendency to sparking will initiate ionisation and subsequent arcing. Quite apart from any effect on the hash problem this will quickly destroy the vibrator contacts.

SECONDARY BUFFERS

The solution is to divide the buffering, (where it is impractical to provide all primary buffering) leaving the major portion across the secondary, but using sufficient across the primary to control arcing.

Whether some primary buffering is required on a 12-volt system appears to depend on the amount of power involved and the design of a particular transformer.

Having fitted the primary buffer we naturally had to reconsider the value of the secondary buffers, the system now showing evidence of too much capacitance. It finally transpired that we had to revert to the original value of approximately .008 right across which, with the primary buffer, gave a reasonable safety margin for wear.

We wanted to retain the arrangement of separate capacitors across each half of the secondary, so we reduced each capacitor to .015 mfd. This is not a standard value, but may be made up from a .01 and a .005 mfd in parallel. There is plenty of room to accommodate the extra capacitors. They are all 500-volt rating.

At the time of writing we have not been able to test the final version of the universal transformer which is in the process of development. An early model has been tested and, in general, proved satisfactory. However, at our suggestion, the makers are modifying the design slightly and it is unlikely that the new model will be ready for this issue. We anticipate that we will be able to discuss any special points in next month's issue.

Also in next month's issue we hope to reprint one of our earlier articles which contained much valuable information on the installation of Karsets. To this we will add data collected more recently, which is appropriate to later model cars.

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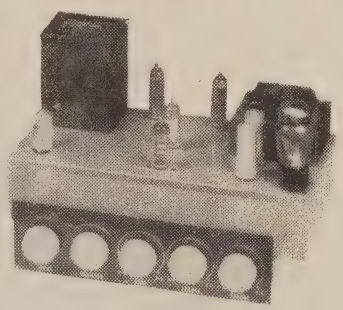

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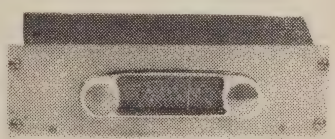

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OFF THE RECORD — NEWS & REVIEWS

One of the most interesting episodes of my recent overseas tour was a visit to Dr. Hermann Scherchen, world famous musician, conductor, and author, who at his home in Gravesano maintains a fully equipped recording studio, where he and his friends conduct experiments in recording and electronic music.

by John Moyle

DR. SCHERCHEN is well-known in this country through his recordings, some of which are among the finest ever made. Most of them have been released by the Westminster Co. of America, and several have won special awards for their excellence.

It is not often that a musician of Scherchen's calibre is interested enough to carry out practical work in the recording field, and after listening to his records, and having read something of his ideas, I felt that I would very much like to meet him.

As my route was to take me through Switzerland, I determined if possible to visit him there, and see and hear for myself about his work.

After some correspondence, it became obvious that this idea was not practicable, because Scherchen was conducting and recording in England as I passed through. But he invited me to stay a few days with him on his return to his home in Gravesano, and so I flew from London to Switzerland for this purpose about the beginning of May.

AT GRAVESANO

Gravesano is a very small Swiss village about 12 miles from Lugano, which I reached by a three-hour train journey from Zurich, through some of the most beautiful lake, mountain and valley scenery in the country. The houses, mostly occupied by Italian-Swiss farming people, are the square, tiled-roofed dwellings typical of that part of Switzerland, and one of these, some hundreds of years old, Dr. Scherchen and his family have made into a comfortable, rambling home.

Together with the other houses of the village, it is grouped half-way up the mountainside, behind it terraced grassland and a vineyard, before it the beautiful valley which runs down to Lugano. In the distance are the eternal Swiss Alps, covered with snow and shot with many colors.

Here he lives and works with his family, when not travelling the world on conducting tours which occupy many months of his time each year.

Madame Pia is much younger than her husband's 65 years, interested in music as it concerns Scherchen, but with mathematics as a hobby.

HAPPY FAMILY

They have three young children, the smallest being about two years old. The entire family accompanies him on his travels. They form a closely-knit, devoted circle, hard-working, full of life and enterprise down to the tiny tot.

I well remember removing the latter from a greengrocer's shop in Lugano, where it was busily occupied with a sackful of small carrots, industriously and methodically snapping them into pieces to hear them crack.

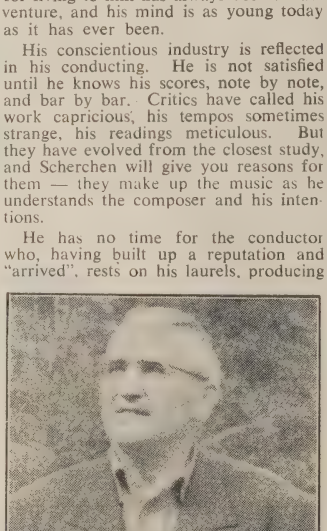
What the proprietor had to say about this I did not wait to hear.

Scherchen is a terrific worker. When not poring over his reference books and scores which were piled around the walls of the library in which I slept, he taps out his articles and books about music on a portable typewriter in the adjoining study, starting virtually at daybreak and continuing late into the night.

The range of his interests is enormous, for living to him has always been an adventure, and his mind is as young today as it has ever been.

His conscientious industry is reflected in his conducting. He is not satisfied until he knows his scores, note by note, and bar by bar. Critics have called his work capricious, his tempos sometimes strange, his readings meticulous. But they have evolved from the closest study, and Scherchen will give you reasons for them — they make up the music as he understands the composer and his intentions.

He has no time for the conductor who, having built up a reputation and "arrived", rests on his laurels, producing



Dr. Hermann Scherchen

the same works year after year, developing no new insight, looking for no new fields.

Such men, he says, are musically dead, as, physically, they might well be.

It is this passion for study and knowledge which has caused him to spend his time and money in new activities; which has led him to build his studios, and cultivate men eminent in all fields of music, acoustics and electronics.

These men, and others who from time to time visit him, are the "Friends of Gravesano". Each year he holds a Symposium at which papers are read and demonstrations given by scientists and engineers from all over Europe.

One of these took place the week after I left Gravesano, and I keenly regretted my inability to stay a little longer so that I could accept his invitation to be present.

AS A WRITER

The papers read on these occasions, together with others contributed for the purpose, are published in a periodical, Gravesaner Blatter, which he edits. Most of these are in German, although there are many articles in English, the whole forming a most absorbing collection dealing with every phase of music and sound.

In addition to his journal, Scherchen has written several books, "The Nature of Music" being available in Australia as a translation. His latest, "Music for Everyman", has just been published in Europe, and in it he describes his own suggested method by which the average listener may understand musical notation, together with some analysis of musical examples in which he delights.

Dr. Scherchen has built two studios adjoining the house, complete with amenities, fully fitted out with tape recorders, playback equipment, a grand piano, electronic organ and echo chamber, the latter being constructed from cellars and rooms in the lower part of the house.

THE STUDIOS

The larger studio, big enough to accommodate a small orchestra (which frequently it does), is completely sound-treated to reduce reverberation. When I was there, the smaller studio was being similarly treated with absorbing units made from the papier mache trays as used to pack domestic eggs for transit.

The entire establishment, including visitors, was busily engaged fitting together hundreds of these trays and piling them against the walls.

The equipment is in the care of a technician, who spends all his time building and operating.

Scherchen's ideas about recording are primarily simple — to see if he can produce better and cleaner records. He is obviously fascinated with the possibilities of modern electronics in this field, and some of his ideas are revolutionary.

For instance, he sees nothing strange in the idea of recording a whole orchestra by using small sections and making them sound like many instruments.

He envisages a technique which will

record, say, four first-class violins in a dead studio, and by means of multiple tape-heads and reverberation chambers, amplifying them into a whole string section. Most of the outer desks, he says, are pretty poor players by the best standards (illustrating the point with a silent but vigorous demonstration) and from a recording point of view, only succeed in muddying the sound.

ORCHESTRAL PLACEMENT

He has definite ideas on orchestral placement, even in the concert hall. He believes it is important for the violins to all face the same way, for the sound of brass and woodwind to reach the listener directly, and not through the sonic barrier of others nearer to the audience, and so on.

With pencil and paper, he makes rapid sketches to show how he would group his orchestra, and bitterly assails the opposition he has met from players and concert managers when he suggests these changes. He believes that the sound he hopes to produce is much more important than convenience and convention.

Electronic music, the design of special instruments to produce it, and the writing of music for these instruments he finds especially intriguing. Realising that many investigators in this field are often handicapped through lack of equipment for their experiments, he will place his own at their disposal, and invite them to spend time with him at Gravesano to continue their activities.

In this, he is undoubtedly doing a fine work, apart from the value of maintaining a centre for the exchange of ideas, and as a meeting place, which he hopes will continue indefinitely. That, I think, is his chief ambition for Gravesano, an ambition which has already received the recognition of UNESCO.

A BIG MAN

Physically Scherchen is a big man, full of the humanities, quick to react and to express his feelings, impatient of the idle and the complacent, active in mind and movement, keenly aware of the world around him, and of the quiet and beauty of the place in which he lives.

When he seizes on a subject which interests him, he is oblivious of his surroundings, and his thoughts emerge with sudden energy and force.

At the breakfast table one morning we began to talk about Beethoven, and soon he was launched on an analysis of a movement from the 7th symphony. Sections of it he reproduced on some scraps of paper, beating out the note values with a pencil and singing the appropriate bars to catch the exact emphasis in his mind, and the manner in which the orchestra should reproduce it.

Several times during that hour he was interrupted by the children, to whom he would turn instantly, and, with gentleness and patience, satisfy with an explanation or an answer. Just as quickly he would return to the subject, which we did not leave until he had completely made all the points he had in mind.

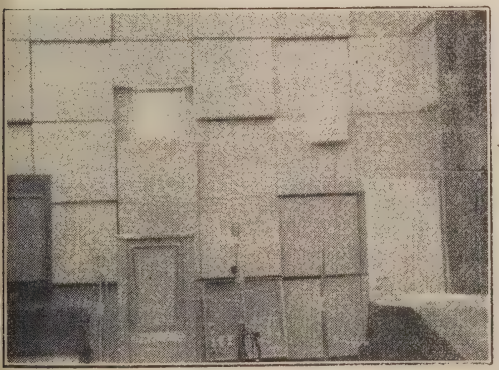
At such times his conversation will jump rapidly through history, philosophy, and in fact anything remotely associated with the subject, for he cannot isolate one idea in his mind without appreciating its relationship to many others.

Among the orchestras he leads, Scherchen has a reputation as a slave-driver, for impatience—even intolerance—for the outbursts of one who does not gladly suffer fools. Many do not take kindly to his views and to the directness with which he expresses them. He is not a man who likes to be contradicted or to be questioned.

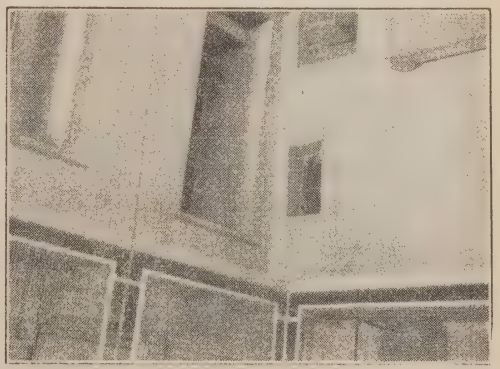
A KINDLY MAN

But he is also a kindly man, one of broad philosophy, as I found in the talks we had sitting under the trees on the hill above his small vineyard; a man of dignity and happy vanity. He will teach his youngest the correct way to use his spoon at the table with the same earnestness with which he listens to his latest recording, or supervises the con-

This picture was taken from the hill behind the Scherchen house looking over the valley below Gravesano. The two sloping roofs at the left are of the two studios, the house itself being at the right.



One of the main studios showing the sound controlling panels, loudspeakers, microphones etc.



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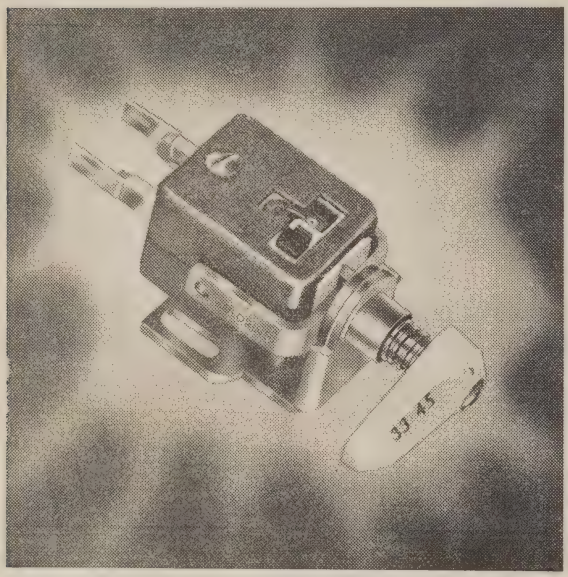

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suction of the tiny swimming pool the garden.

We said good-bye at the garden gate. I was about to leave for the train rney back to Zurich.

"If you write about what you have n here," he said, "don't forget to them about the love in this place. about the children."

★ ★ ★

DVORAK — Slavonic Dances Nos. 1-16.

TCHAIKOWSKY—Romeo and Juliet Fantasy Overture. Played by the Vienna Philharmonic Orchestra conducted by Rafael Kubelik. Decca LXTA—5070/80.

Kubelik conducted this orchestra in Royal Festival Hall earlier this year. brought down the house when he luded some of these dances as en- es.

The orchestra played them, as it does these records, with tremendous ality and exuberance, and with a thm which is more than just a mat- of timing.

Kubelik keeps his sentiment well in nd—indeed his pace gives little op- rtunity for much display of it. The ording emphasises the impression of d drive, particularly as it is rather sely miked.

Hall reverberation is noticeable in the tance, but it gives life to the perform- ce. The recording level is very high, d groove echo is apparent here and re.

High frequencies are prominent — nbals clash and triangles ring—but bass isn't so heavy. Some might nk it an improvement to cut the top d boost the bass a little.

But altogether it is a brilliant and fceful job. The playing is often perlative, and the music always en- nting in a way which is duplicated nothing else.

These dances are ideal to show the power and response of the Vienna Orchestra, whose resources are virtually inexhaustible. No matter how severely it is pressed, the players always seem to have plenty to spare.

Use the RIAA curve, or the EMI if you think the tops too prominent.

Romeo and Juliet has altogether remarkable fire and vitality. I have rarely heard anything worked to such a pitch of excitement as its finale. But there is much more to it than this.

In the wild interplay of sound you will hear the viciousness of mortal combat, the fast flicker of steel, the hard glitter of eyes, the deadly unmasking of hard-pressed men to kill or be killed, the desperate and shocking end, and the appalled quiet after the storm.

It is all there, clearly etched against a background of horror and conflict more vividly portrayed, perhaps, than anywhere else in music.

I think this is one of Tchaikowsky's most successful compositions, in that it so completely succeeds in what it sets out to do, and because he is so superbly equipped to write it.

SOME COMPARISONS

There is an HMV by Cantelli which is a strong opponent of this disc, but despite its air of hurry and its high speed attack, it does not reach the vivid picture painting of Kubelik. Then there is a fine version by Scherchen for Nixa, which unfortunately has rather a high surface level.

It is rather fascinating to compare the final sections of each.

Cantelli is fast, and rather perfunctory here, as though for him the climax is past and the last bars an anti-climax. Kubelik has appreciated much more fully the solemn funeral march of this section.

Scherchen has obviously given this section greater thought. His crashing drums have an almost frightening impact as the conflict ends, and he highlights their steady beat in the dirge which follows. He uses them again to build up a final crescendo, thus making the coda an eloquent and integral part, without which the music is not completely finished, but which many see as merely a conventional flourish.

Kubelik's recording is not as good as in the Slavonic Dances, but the surface is beautiful—not a sound to spoil the effect of the extremely wide dynamic range.

Quite a release!

★ ★ ★

SAINT-SAENS — Concerto for Piano and Orchestra No. 2 in G Minor, Opus 22. D'INDY—Symphony No. 1 for Piano and Orchestra in G Major, Opus 25 (on a French Mountain Air). Played by Jean Doyen with l'Orchestre des Concerts Lamoureux, conducted by Jean Fournet. Philips N00233L.

Well-grouped are these two contemporary French works, as much for their content as anything else.

Both lean rather too heavily on the piano to be considered concertos in the true fashion. The Saint-Saens is brilliant, easy to listen to, with few real ideas, mostly improvised, and with more than a hint of the commonplace.

Here the pianist has striven hard to invest it with a garb more eloquent than it deserves, and he does it so well as to be quite convincing.

He is wise, as his style is sensitive

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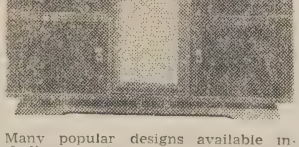

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rather than strong, and he does not appear to be the man to hammer out the music as so often is done.

I thought he showed his best work in the much more rewarding D'Indy, strongly reminiscent of Cesar Franck, who was the composer's teacher.

It is indeed a lovely little work, and has few of the bare bones which are apt to rattle in the Saint Saens.

The orchestral tone on both sides is rather shallow. It may lack some weight, and more reverberation I think would have improved it.

Not a highly impressive record as far as sound goes, but it is musical and sensitive, and drawn on a smaller scale than the more full-blooded discs we are accustomed to hear these days. It should win many admirers.

★ ★ ★

SMETANA—The Moldau; from Bohemia's Forests and Meadows. Played by the Berlin Philharmonic Orchestra, conducted by Ferenc Fricsay. DGG 17018LPE.

A good record, particularly the Moldau side.

The sound is typical of that DGG quality — smooth, satisfying, well defined, without any particular claim to brilliance or higher-fi.

There is hardly need to detail the source of the music, which is among the best-known smaller concert pieces.

I liked, particularly, the manner in which the essential sections of the orchestra are so clearly heard without in any way spoiling the flowing line which holds them together. You will note particularly the beautifully played horn passages and the fine definitive work of the violins.

"Bohemia's Forests" is played in similar vein.

The only other contemporary I have is the Telefunken version released some time ago which, despite its more immediate sound, is rather heavy-handed by comparison.

As usual, the DGG surface is first-rate.

★ ★ ★

BEETHOVEN.—Symphony No. 5 in C minor, Opus 67. Played by the Berlin Philharmonic Orchestra, conducted by Eugen Jochum. Philips A00766R.

This is a classical Fifth—a four-square performance in the traditional manner —no new-fangled ideas, no messing about with tempo or digging into the score for unusual results.

On these grounds alone it might be preferred by those who wish to avoid so-and-so's "version", for it is an eminently safe performance.

Personally I would have liked a faster tempo almost throughout, and particularly in the second and third movements. There is great liveliness and strength in this orchestra, so that no one could honestly maintain there is any sense of dragging or lagging on the way. It is a performance obviously meant to be that way.

But it is undeniably slow, and even heavy-handed in places.

In the third movement the interest is heightened by a bass which might even be over-weighted, but how those big fiddles do sound! I fancy they have been bumped up for the occasion, as they bring with them a slight rumble and added background of liveliness which indicate that someone has done things with the controls.

In the last movement, too, this strong bass is a feature. At one spot, just before the second crescendo, you will distinctly hear the operator advance the bass control a full notch to complete alter the nature of the sound.

The last movement is possibly the best of the four, and concludes the symphony on a convincing note.

Recording amplitude is somewhat lower than average; maybe it has something to do with the compression of two movements to each side. In general the dynamic range is quite good, and it isn't a model of Hi-fi, it has good body and should sound well under all conditions.

Surface noise isn't quite as low with most Philips discs. It's extremely good value as a 10-incher.

★ ★ ★

BRAHMS.—Sonata No. 2 in A major for Violin and Piano, Opus 100 (Thun.). Schumann—Sonata No. 1 in A minor, for Violin and Piano, Opus 105. Played by Rafael Druin and John Simms. Mercury MG80002.

Of the two sonatas I liked the Brahms the better, partly because it is better music—and I think you'll appreciate the fact from the first bars—and because the players themselves seem to be more interested in it.

They blend better, and the recording seems to be a little superior to that on the other side.

The violinist is heard to best advantage. There is a peculiar hesitancy and lack of decision about the pianist, although he is deliberately effacing himself, or has been told to damp down on his power. In the Schumann, particularly, a few notes were either lost altogether or sounded so diffidently that they may as well have been.

Technically, it is a sharp disc, the violin being extremely forward. There is little primary reverberation, but sometimes a delayed echo effect made me wonder whether a reverberation chamber was giving some discreet assistance or it may have been merely a bounce off a comparatively distant wall.

In the Brahms, particularly, the violinist can be heard with some quite audible breathing. I'm not being funny when I say that even this tends to highlight a most pronounced sense of intimacy about the record, made all the more effective by an almost silent surface.

Nice work.

★ ★ ★

BERLIOZ—Les Nuits d'Ete Opus 7, La Captive Opus 12, Le Jeune Patre Breton Opus 13 No. 4, Zaide Opus 19 No. 1 (Bolero). Sung by Eleanor Sterber with the Columbia Symphony Orchestra conducted by Dimitri Mitropoulos. Philips N02115L.

I am not familiar with these extremely beautiful songs, but after hearing this disc I intend to remedy my misfortune as rapidly as I can.

To strike such a lovely record among a procession of new versions of familiar works makes up for many conscientious if sometimes unrewarding hours.

It illustrates, too, another fascinating facet to the work of this remarkable composer, an extremely important figure in musical history.

This record has a deadly clarity — enough, in fact, to make me wonder a little at some of the notes produced by the singer.

THE WORLD'S FIRST CIRCULAR OFFICE BUILDING

A feature of the Hollywood landscape is this newly completed building which houses the headquarters of Capitol records, a company now owned by EMI. It is claimed to be the first of its kind in the world.

The building diameter is about 92ft. This is about the maximum diameter, that is practical, because if it were greater corridors would be required from the centre to the outside wall in some areas.

The gross area in the building is about 93,000 sq. ft, net usable area is about 80,000 sq. ft, or approximately 85 pc of the gross. Capitol is occupying the first, second, third and the ninth through the 13th floors. The remaining floors four through eight inclusive, will be rented.

The height to the upper roof is 150ft, which is limit eight. The height of the spire is about 90ft.

The building is round for functional reasons, as well as design. The round structure results in less outside surface in proportion to the usable interior area. This reduces the outside wall surface which saved in construction cost and in air conditioning operation cost.

At the top of the spire is a beacon light, which will be lighted each night and will flash in Morse Code the word "Hollywood". In the Penthouse on top of the building is the elevator machinery, various fans and blowers, and a cooling tower.

The sunshades of the building deflect the sun for protection of the interior as well as to reduce the air conditioning load. These sunshades are permanently mounted, and are made of porcelain enamelled steel.

The studio construction is particularly interesting. The outside walls are of concrete 10in thick. The inside walls are completely separate from the outside walls, are built of steel studs, acoustic plaster and acoustic tile, and stand on a separate floor which does not touch the outside wall. The inside floor is a 3in concrete slab, resting on a 2in layer of cork, which in turn rests upon a foundation slab, 6in thick.

The wood panels hanging on the studio walls in zigzag pattern, are called "splays". These panels swing either way to expose, in one direction, a wood surface to make the wall of each studio half hard (wood and acoustic tile) or all soft (acoustic tile only). This is an important factor in achieving the correct sound in the studio.

Is her voice showing signs of wear, I wonder, or could the microphone have been more happily placed?

Mostly, however, her lovely tones, vaguely reminiscent of Callas, are a delight to hear.

The orchestral accompaniments are nicely balanced, and the surface, despite a click or two, is quite unobtrusive.

A valuable point—the words of the songs, in French, are on the back of the jacket, although unforunately there isn't room for any commentary about them. Unless the listener is better informed than I am, he will miss it.

SIBELIUS—Concerto for Violin and Orchestra in A Minor Opus 82. Glazounov—Concerto for Violin and orchestra in D Minor, Opus 47. Played by Thomas Magyer and The Hague Philharmonic Orchestra conducted by Willem van Otterloo. Philips A00269L.

Two full-sized works on a single disc make an attractive buy at any time, for good discs are not cheap. On such a round alone, this one will have an immediate appeal.

Does this compression into single-side presentation have any disadvantages?

I think it does, but the average listener may not be particularly conscious of them.

Only by close groove spacing, and fine control of "micro-grading" can more music be fitted to a single side. And closer spacing means that the dynamic range — contrast between softest and loudest passages—and frequency range as well, must be to some extent sacrificed.

Both these limitations are present on this disc, and although they do tend to level out the light and shade, it would be wrong to discount it too severely.

Indeed, I fancy that once or twice the engineers have deliberately given one or two loud passages a little extra latitude so that the flattening out of the dynamic range should not be noticed too severely.

In achieving their object of saving disc space, I don't see how they could have done it more cleverly.

Judged objectively, the Sibelius has not the vigor or mastery of the recent Ois-

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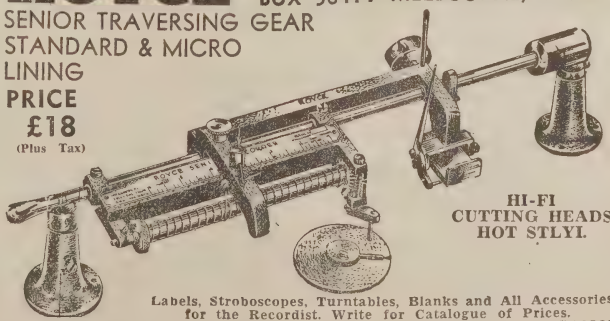

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akh version, but this is true of most thers. Magyar lacks a certain thrust nd immediacy, nor is he always techni-ally faultless. His general approach is ltogether milder, but frequently he roduces some extremely beautiful play-ng.

The warm and lively Glazounov de-erves more frequent performances, and thought it the better side.

In both cases the orchestra is sound ather than brilliant. The surface is a ood one.

Maybe this record doesn't climb the ighest mountain, but it is good value, nd is well worth a hearing.

Tschaikowsky—Manfred Symphony Opus 58. Played by the Philharmonia Orchestra, conducted by Paul Kletzki. Columbia 330CX1189.

This work is not numbered among the egular symphonies, and it is really a ymphonic poem or tone poem in four novements, the subject matter being uilt around incidents from the poem by Byron.

It is therefore a programmatic work, omething of a blend of the numbered ymphonies and Tschaikowsky's ballet nusic.

One has no difficulty in catching flash backs to the 4th and 5th symphonies be-ween which it was composed, as well as to several other works.

Of Manfred, the composer said, "My Manfred will be played once or twice, and then will disappear for a long time; with the exception of the few con-noisseurs who attend symphony concerts no one will know it."

This is exactly what has happened. Although Tschaikowsky is reported to have considered Manfred as his best orchestral piece, it is possible this opinion was inspired by the amount of work he put into it, rather than as reliable judg-ment.

To my mind, there is little in it which has not been better done else-where. Too often it sounds merely an exercise in the Tschaikowsky formula, with not very much to say.

The recording is particularly clean and incisive, which gives shape and vivid brass, definition to orchestral sections, but a bass end somewhat underweight. Reverberation isn't very noticeable—it is more like some American discs than a typical Philharmonia.

The playing is high class, and no one need fear on that score. Maybe the EMI curve will sound best.

★ ★ ★

CHOPIN—Recital by Malcuzyn-ski (10 numbers), Columbia 330 CX1338.

For Chopin lovers, this is a tempting array. Most of the prime favorites are here, and as Malcuzynski has proved him-self a most competent and popular per-former, this disc is bound to sell well. At least, no one can quarrel with the dynamic fire he unleashes, or fail to appreciate the sympathetic handling of so many beautiful melodies.

But I do wish he would learn to iron out his extremes of tempo, his habit of pulling up and dashing off again in all kinds of odd places, like a new car driver with a hot engine and touchy brakes.

I find this habit so irritating as to al-most cross him off my list of Chopin players, despite many other good points.

I feel this mannerism really is a habit, for he often leaves himself with an anti-climax on his hands, with some awkward and ineffective bars to handle before he gets going again.

The recording allows him to build up terrific tone and power, sometimes with-out stress, but I fear that good equip-ment will detect overload on many chords, as, for instance, in the B flat minor Scherzo. This hardens the tone and spoils what might otherwise have been a smashing effect.

There are other technical faux pas, in-cluding a prominent A flat in the G flat major Waltz, which sounds like a sonic knockout. There is also some slight sur-face swish near the end of the first side.

Despite these drawbacks there is plenty of good playing to be heard, and you mightn't be as critical as I am.

The RIAA curve seems as good as any

★ ★ ★

MASSENET — Scenes Pittor-esques, Scenes Alsaciennes. Played by l'Orchestre de la Societe des Con-certs du Conservatoire de Paris, conducted by Albert Wolff. Decca LXTA5100.

The excellent standard of recording lifts this record into a class of its own, as far as the music is concerned.

To me it has always been a curious mixture of charm and commonplace, and we can only be thankful that someone has elevated it from the rather ordinary rut along which it usually makes its way.

Be that as it may, the French players and Decca between them have undoubt-edly given the best and most engaging performance I have yet heard on a record.

All the fetching little jingles and wood-winds are heard with full clarity and they are balanced against an extremely well-proportioned bass.

The sound, too, has a fresh airiness about it, most effective in the broad, flow-ing passages that occur frequently on both sides, and in the flashes of flutes and horns as they go about their rustic and sylvan business.

In short, a bright disc, impeccably played, and showing to best advantage some of Decca's best recording.

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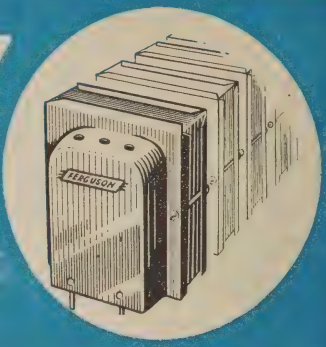

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40 WATT P.A.	(RT & H JUNE '50)	PF173	CF103	OP17
10 WATT P.A.	(RT & H SEPT '53)	PF170	CF105	OP58
PLAYMASTER No. 1	(RT & H OCT '51)	PF173	CF111	OP25
PLAYMASTER No. 2	(RT & H NOV '51)	PF152	CF196	OP63
PLAYMASTER No. 3	(RT & H JAN '52)	PF170	CF105	OP113
PLAYMASTER BABY No. 4	(RT & H DEC '51)	PF151	CF103	OP183
PLAYMASTER No. 5	(RT & H JUNE '52)	PF167	CF109	OP66
BATTERY PLAYMASTER	(RT & H MAY '53)	VT104	CF119 / CF108	OP24
UNIT PLAYMASTER No. 6	(RT & H JAN '54)	PF130	CF104	OP63
PLAYMASTER No. 7	(RT & H JUNE '54)	PF152	CF196	OP63
PLAYMASTER No. 9	(RT & H MAY '55)	PF152	CF196	OP301
PLAYMASTER No. 10	(RT & H AUG '55)	PF152	CF196	OP301
PLAYMASTER No. 11	(RT & H AUG '55)	PF152	Not used	OP301
PLAYMASTER No. 12	(RT & H SEPT '55)	PF1067	CF110	OP312
CRYSTAL PLAYMASTER No. 13	(RT & H JAN '56)	PF151 or PF170	CF103 or CF104	OP24
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GERSHWIN—Rhapsody In Blue; An American In Paris. Played by an unnamed orchestra conducted by Paul Whiteman, with Leonard Pennario, pianist. Capitol T303.

A much more acceptable version of) Rhapsody than Mantovani's effort viewed last month. Paul Whiteman roduced this music in his famous n, and his touch is still there. The and is good, and I'd rate it a safe y.

★ ★ ★

MENDELSSOHN—Symphony No. 4 in A major (Italian). SCHUBERT —Symphony No. 8 in B minor (Unfinished), played by the Philharmonia Orchestra, conducted by Guido Cantelli. HMV OALP1325.

This is an outstandingly good disc hich performs two tasks very effectively. It provides a potent answer for those ho are inclined to belittle Mendelssohn s a symphonist, and it affords a perfect ample of the real quality of the Philrmonia Orchestra.

The best thing about it is the first ovement of the Mendelssohn symphony, hose opening bars burst upon us like e sudden warmth of sunshine on a ring day. What a lovely piece of work is! And how joyously and magnifintly the orchestra enters into the spirit the music. I don't imagine you will er hear a better example than this of st-class English orchestral playing.

Cantelli, as always, shows his impecble judgment in setting his tempos and seeing that the orchestra — every an — observes them to the microcond.

At the same time, he is much more an a drill sergeant. Such beautiful ecision and lively playing is just the sult of a fine combination showing off real form under a conductor for hom its members are prepared to do eir best.

Maybe I was unlucky to have played this side before the Schubert, but I thought it might have sounded better under a more sympathetic hand than Cantelli's.

At least, the music is not allowed to languish, and with the players in this mood, a distinguished performance is inevitable. This we receive, and if the hand that guides it isn't exactly a loving one, it is always sure and intelligent. You may even prefer it this way.

Technically, this is as good a disc as HMV have given us in a long time. It has scads of dynamic range, a most impressive warmth and weight, and is always clear and clean.

It has the lively sound of a Kingsway Hall job, bright, with just the right degree of reverberation and a splendid instrumental balance. The surface is inaudible.

It hovers very close to the five stars.

★ ★ ★

DELIBES—Coppelia Ballet Music. Played by the Royal Opera House Orchestra of Covent Garden, conducted by Robert Irving. HMV OCLP1046.

This bright and tuneful ballet had the good fortune to meet with success right from its first performance, not the least contributing factor being the tuneful, bright and interesting music provided by Delibes.

No programme of light orchestral music can achieve any proportions without including at least one episode from it. Its position as a minor classic is as firm now as it was in the beginning.

It stands to reason, therefore, that a first-class performance is always assured of success, and that is just what we have here.

I started out to make a few notes on the relative merits of the various sections as they came along, but soon abandoned the process. For this is a remarkably even piece of work, and I can only recommend it heartily.

The orchestra isn't heavily weighted, but, of course, there is little occasion for this. What is more important is its flexibility, balance and clarity, all of which it has in good measure. Within these limits there is technically not a cloud on the horizon from start to finish.

A little bass reinforcement over the RIAA curve is worth trying, otherwise it scores very highly.

"Smithy" again

TWO nephews of the late Sir Charles Kingsford Smith landed recently at Bankstown, NSW, after a 14-day flight from England in a light plane.

Mr. Rollo Kingsford Smith, an Australian aircraft company executive, piloted the plane.

His brother, Mr. John Kingsford Smith, a Sydney film producer, filmed the flight.

In 1930 Sir Charles Kingsford Smith flew a single-engined aircraft from London to Sydney in 13 days.

He disappeared in November, 1935, in another attempt to fly from England to Australia.

Mr. Rollo Kingsford Smith said: "We took our time on this flight, and did not try to break any records."

Flight-Lieutenant S. W. Peak, RAAF, was second pilot on the flight.

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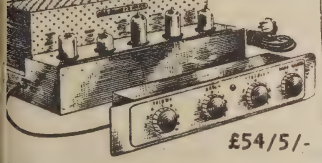

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SHORT-WAVE NOTES BY ART CUSHEN

VOA IS USING 78 TRANSMITTERS

With a network of 78 transmitters, the Voice of America must rank as one of the world's major broadcasting organisations.

THE latest issue of the Voice of America program guide discloses that VOA now operates some 78 transmitters in various parts of the world. The large increase in transmitters places the Voice of America well at the forefront of the world's broadcasting organisations, and VOA must therefore operate the most stations.

The VOA program guide, which is the first to be published for several years, and this new publication, put out with co-operation of RCA International, is available free from the Voice of America, Washington 25, DC.

FORTY-ONE LANGUAGES

A total of 41 languages are now carried over VOA transmitters which include some 30 stations in the United States which are privately owned and in operation for VOA programs. These stations are WLWO (Crosley Broadcasting Corporation, Cincinnati), WRUL (World Wide Broadcasting Corporation, Boston), WDSI (Columbia Broadcasting System), WGEO (General Electric Company, Schenectady, N.Y.), WBOU (National Broadcasting Company, New York). These transmitters are located at Bethney Ohio; Scuitate Mass.; Brentwood N.J and Boundbrook, N.J., respectively.

On the Pacific Coast transmitters are KCBR (Columbia Broadcast System Delano , California), KNBH (National Broadcasting Company, Dixon, California), and KGEI (General Electric Company, San Francisco, California).

Relay stations are located at Manila and Luzon, Philippines; Honululu, Hawaii; Munich, Germany; Okinawa; Colombo, Ceylon, Tangier; and Salonika, Greece, and from the seaborne relay base, Courier, at Salonika.

The above stations are Government owned and controlled, while the Munich, Okinawa and Luzon transmitters operate with a million watts, the world's most powerful known broadcasting facilities.

Relay facilities are also leased from the BBC in England.

Many other relay or rebroadcasts are made through arrangements with local broadcasters, throughout the world. Thus the programs received may have originated in the United States, but may have been rebroadcast or relayed from one of the VOA relay bases VOA, in addition to regular broadcasts, provides many programs on transcription

FROM THE MAIL BAG

THIS month the mail includes verifications from Peru, Northern Rhodesia, South Africa, and Tangier. Fuller information is given about the stations.

ZQP at Lusaka, Northern Rhodesia confirms the reception of the two transmitters on 3915 Kc (2500w) and 4826 Kc (15.000w) with a plain white card, signed by the Broadcasting Officer Information Department, Box 209, Lusaka. Signals from the station are still being heard to sign off at 5 am.

OBX4U, Radio America, Apartado 1192, Lima confirms our reception of the transmissions on 3240 Kc, where they use 500 watts, with a white and blue card. The network is OAX4U (1010), OAX4V (5925), OAX4W (9360), and OBX4U.

WTAN, The Voice of Tangier, confirms reception with a folding card, signed by Miss Jane McDonald. The station has the mailing address of Box 219, Tangier, Morocco, and WTAN is the radio voice of International Evangelise, Inc., of Greensboro, N.C., USA. WTAN uses 10,000 watts and is at present heard on 9490 Kc to 6 pm on Sundays.

SOUTH AFRICAN BROADCASTING CORPORATION, PO Box 8606, Johannesburg, confirms reception on the test transmissions on the 20.000 watt Paradyse transmitters. The commercial service is still broadcast from the old Johannesburg transmitters, but English and Afrikaans is released on the new station. The 11, 16 and 19 metre transmitters are beamed north so that reception of them in this area is doubtful, but good signals are being had on 4810 and 3290 with English news at 5 am and on 3380 in Afrikaans at 4 am

Athens using 11927 KC

STRONG signals from Radio Athens, in Greece, are being heard in this area, when the station opens transmission on Sunday at 3.30 pm

The channel is only two kilocycles clear of HCJB, but this interference is not very severe. The two stations at this hour are in the same vein; both have religious broadcasts. The Greek station has a church relay which is heard till after 5 pm, the same program being transmitted on 9607 Kc

BROADCASTS FOR AUSTRALIA

Two broadcasts for Australian and New Zealand listeners are scheduled, the Music USA program at 8.00 pm to 10 pm on 9590 Kc, and the session of News, Commentary and Features 9.30-10.00 am using 21740, 15245 and 11765 Kc.

The latter session is intended for South Asia and is not an optimum listening time. A further transmission at 11.30 pm to midnight, is carried on 15425, 11850, 9650, 9590 and 6020 Kc. This program is also of news and features, and is well received though listening time is somewhat late in Eastern Australia and New Zealand.

NOTES should be sent to Arthur Cushen, 212 Earn Street, Invercargill, N.Z. All times are Eastern Australian.

Thirteen Metres Active

SIGNALS on the higher frequencies have made a marked improvement as summer advances, and at 9 pm and again at 6 am many new stations and frequencies have been noted in operation.

Lisbon is using the new frequency of 21700 Kc, and has been heard at fair strength at 6 am. Many transmitters of the Voice of America and Radio Free Europe are well received at both periods. Radio Pakistan is using 21590 to closing at 6.45 am, and in the evening at 8 pm All India Radio, Delhi uses 21650 Kc in the Service to Australia, to good effect.

Higher in frequency, the 11 metre band has been found to provide good signals at 9 pm when the two BBC channels predominate, also to be found later are two Voice of America transmissions and the Austrian station reported elsewhere on this page. The present schedules of the Voice of America stations in the 13 and 11 metre bands are:

Kcs	Call	Schedule
21455	Tangier-7—10.00 pm-3.30 am.	
21460	KNBH-1—9.30 am-noon. 1.00-1.15 pm (Sat.)	
21485	WLWO-2—12.15-7.30 am	
21500	KNBH-3—10.00 am-10.30 am.	
21500	Tangier-12—10.00 pm-1.00 am.	
21500	WDSI-5—3.30-7.30 am.	
21515	WLWO-6—12.15-7.45 am	
21540	WBOU-1—12.15-8.00 am	
21570	Philippines-2—12.15-12.30 pm.	
21570	WDSI-1—12.30-3.15. 5.00--8.00 am.	
21590	WGEO-3—12.45-7.45 am.	
21610	KCBR-1—10.00-10.30 am	
21610	KNBH-2—11.00-11.15 am	
21610	Tangier-12—1.30-6.30 am.	
21630	KCBR-2—7.30-10.30 am.	
21650	WLWO-4—12.15-8.00 am.	
21690	Tangier-9—8.00 pm- 12.15 am.	
21690	Tangier-9—12.15-3.30 am, 3.30-5.00 am	
21710	BBC—12.30-2.30 am, 3.00-3.30 am.	
21730	WBOU-3—12.30-3.30 am, 3.30-8.45 am	
21740	BBC—11.45 pm-midnight. 12.15-12.45 am.	
21740	KSBR-7—7.30-11.00 am.	
25670	Tangier-2—10.00 pm-3.30 am.	
25920	Tangier-8—10.00 pm-12.15 am, 12.15-2.30 am.	

FLASHES FROM EVERYWHERE

ARGENTINE station LRU has been heard on a frequency of 15290 Kc in Melbourne from opening at 8 pm reports Stuart Morris. The station has been requesting reports from listeners and has been well received till lost to a jamming interference at 9 pm. The English identification at 8.00 and 9.00 pm gives the stations as LR1 on broadcast band, LRX on 9660 and LRU on 15290 all broadcasting from Buenos Aires.

RADIO GOA in Portuguese India using 4890 Kc has been heard at 2.00 am with the English broadcast which continues to the sign off at 3.00 am. Signal is fair after the Perth transmitter VLX4 leaves the air.

Signals are weaker than the two nearby Colombo stations, the Home service on 4900 Kc and the Commercial Service of Radio Ceylon using 4870 Kc to sign off at 2.30 am The Goa station operates with 5000 watts

AUSTRIAN high frequency station OE130 on 25945 Kc has been heard in Australia in the transmission to North America in the 8.20 9.20 pm service. Identification was given at 9 pm and the closing announcement is in English. The signals are weak in Australia, and appear to be better in North America. At times the signals are heard at strength that is good enough for a report, but the signals are far below those of the BBC in the 11 metre band.

HILVERSUM'S new 100 Kw transmitter is now in operation. News that this would take place was given in a recent broadcast in Eddy Startz's Happy Station Program. The present signals from Holland on 17770 Kc at 7 pm in Dutch and at 7.45 pm in English are therefore expected to show an improvement in this area.

MALAYA'S transmission reported last month on 9615 Kc has now returned to its former frequency of 7200 Kc. Signals are fair on this channel and news in English is presented at 9.30 pm

CUBA'S shortwave transmitters have in the past few years somewhat declined, and the stations which all relay a broadcast band program, now number only five. The CHOL transmitter, Radio Aeropuerto Havana, operating of 9833 Kc operates 10.00 pm-4.00 pm using 1000 watts, and relaying CMBL. The address is Aeropuerto International, Jose Marti Ranchel Boyeros, Havana.

EL SALVADOR station YSMA, La Voz Superna Occiente operates 10.00 pm- 2.00 pm using 500 watts on 6180 Kc watts. News in Spanish is 11.30 pm, 4.00 am, 9.45 am, 1.30 pm. The address is Apartado Postal 198, Santa Ana, Salvador

FRENCH TOGOLAND has a new shortwave station, reports World Radio Handbook. This transmitter, using the call, Radio "Lone" Lome operates 10.00-10.15 pm, 4.30-6.30 am, in French Mina and Ewe, news in French is broadcast at 6.00 am on 5036 Kc.

LAOS in the Vietnam area, operates Radio Laos Vietnam is on the air 11.00 am-noon, 4.00-5.00 pm, 9.30-12.30 am. The station uses 6130 and 7145 both with 10.000w French is broadcast midnight-12.15 am.

ROUMANIA'S Radio Bucharest, is using a new 25 metre frequency of 11937 Kc, which is in chain with 9570 Kc, when both stations carry a daily musical program with English announcements. 2.00-3.00 am

AFRICAN signals are reported by John Campbell of Adelaide who is finding interesting signals in the 90 metre band in the early morning. The Accra station in the Gold Coast which formerly operated on 4910 Kc has been noted on 3365 Kc with local news at 3.45 am and a relay of BBC news is released at 4 am

Two nearby transmitters are the Tanarive station on 3386 Kc which broadcasts from Madagascar, and closes at 4 am with the French National anthem, which is preceded by announcements in both French and English. Reunion Island operating from St. Denis has been heard on 3380 Kc, the station closing at 3.30 am

MANILA'S transmissions from the Far East Broadcasting Company, now has a special transmission directed to listeners in Australia and New Zealand, released over the usual frequencies of DZH9 15300 Kc, DZH8 11850 Kc, and DZH7 on 9730 Kc. The transmission is timed from 6.00 to 8.00 pm and includes many of the missionary features which are noted from the Call of the Orient

THE HAM BANDS WITH BILL MOORE

The frequency limits of amateur operating bands are decided upon at international conferences. It appears that amateurs will operate under current privileges for quite a long period as the holding of the next ITU conference is not envisaged until 1959.

ENERAL impression gained to date, is that no International Telecommunications Union lio Conference is likely to be held before at 1959. The possible venue of the conence will be Geneva, Switzerland.

was decided at the Stressa Region 1, IARU erence, that up to three delegates represent- amateur radio in Region 1 (Europe and ca), should be appointed to attend the next Radio Conference.

is anticipated that the conference will be ducted along similar lines to the last at ntic City and will run for a period of months.

pinion is still varied as to the value of representation, but the experience of the B delegates who attended Atlantic City ved much work of value can be performed

TENTION OF BANDS

t Stressa, ARRL and IARU Secretary Bud-, WIBUD, pointed out that IARU repre-atives at ITU conferences could not ensure retention of amateur bands. National gations arriving had already received their uctions and it was then too late to ince major policy.

e stated it was very necessary for all Nat-l Societies to be in close liaison with their inistrations and to see they are favourably fed on the amateur radio viewpoint before arrive at the conference.

hese events are a battle of tactics with each inistration trying to further its own inter-it is apparent the most important work done by National Societies during their ine contacts with their regulatory authorities. he deliberate jamming of commercial stations rating on the 3.5 mc/s band was deplored. Europe and most other areas this band shared with other services. The Stuttgart ateur Radio Club had been organising jam-g sessions on B/C stations on these fre-ncies.

complete list of non-amateur stations heard the exclusive amateur section of the 7mc

band will be prepared by all national societies. Traffic handling between DL4 (American Service Personnel) stations and W amateurs has been discontinued. Interference from high-powered DL4 stations had been a source of worry to European amateurs over a number of years.

The European CW-Telephony Band Plan was again endorsed with the exception that the exclusive CW portion of 14 mc/s was reduced by 50 kc/s, to read 14.000 kc/s to 14100 kc/s. Other CW operating allocations are as follows: 3500—3600 kc/s. 7000-7050 kcs, 21000—21150 kc/s, and 28000—28200 kc/s.

A proposal that the 10 kc/s, 14100—14110 kc/s, should be set aside for rare DX stations was defeated. It was pointed out that amateurs were already pressed for spectrum space and exclusive allocations for stations could not be recommended.

The following amateur activity figures were recorded after investigation by the German National Society, the DARC. About 25 per cent of all licensees are active, of these 35 per cent use CW exclusively, 25 per cent telephony only, and 45 per cent a combination of both.

Approximately 30 per cent of the stations active use the 3.5 mc/s band, 20 per cent the 7 mc/s band, and between 35 per cent and 40 per cent are on the 14, 21, 28 mc/s bands. Compared with VK activity CW seems more popular in Europe as does 3.5 mc band operation.

The establishment of an International emergency calling frequency was also discussed and delegates outlined the emergency nets organisations in their respective countries. European stations are not permitted to operate in either 56-60 or 50-54 mc/s bands and societies will request permission to use from 72 to 72.8 mc/s.

This band was granted at Atlantic City to the governments of France and Russia for amateur use and will permit some active part in observations during the International Geophysical Year.

BIG PLANS FOR WOY WOY THIS YEAR

HE 1956 NSW Division's Woy Woy Field Day will be held on November 18, when iters from the Hunter Branch and Syd-and Districts area have an opportunity of ting. These events are always well attended for the past six years have exceeded the mark.

ssembly point is as usual at the Masonic l, Woy Woy, with registration commencing 10 am.

he morning session comprising competitions commence at 11 am and the All-Band mble will be conducted during this period. he lunch break will be from 1 pm until m. At 2 pm searchers will leave on the mc/s Hidden Transmitter search. Special nts will be run during the afternoon for ladies and the junior operators.

rom 4 to 5 pm amateurs will gather for presentation of prizes.

/oy Woy provides excellent entertainment year and a reasonable Sunday outing n either Newcastle or Sydney. There will plenty of prizes, disposal gear Bring your ily for a day's enjoyment.

DERAL CONVENTION

ews that a Federal Convention of the Wire-Institute will possibly be held next year be welcomed by most amateurs. These ventions were annual affairs for many years the last meeting was in 1953.

is essential for the well being of the by in Australia, and the WIA in particu-that representatives of all States should ier to discuss and clarify problems that e from time to time. They are certainly ly but are the only effective means of ab-ing a true opinion of Australia-wide re-on.

a united and representative front is to presented on amateur radio affairs it is ntial that the Federal Executive be fully fed.

V has brought a new problem to amateurs. to date amateur radio has been effectively resented. A Federal Convention would be to endorse action taken to date and bring ward new ideas for further action.

October hunt

RESULTS of the NSW VHF October Nocturnal 144 mc transmitter search saw Dave Andrew, VK2AWZ, arrive at the hidden spot in 53 minutes, a solo effort. Second John Peell, VK2WJ, third Horry Lapthorne, VK2HL. The carefully selected location on the upper reaches of the Georges River gave the searching parties some problems. Bob Winch VK20A was the FOX a forward for his continued success in these events.

144 mc activity in the country is still on the increase with four amateurs active in the Tamworth area, VK2APF, VK2LY, VK2ATS, and VK2ZAD.

The Coffs Harbour gang will shortly take the air on 144 mc/s. Phil Cox, VK2IE is the latest on in the area west of Sydney and uses a five over five array from Bathurst.

Specialisation

OFTEN we do not appreciate the implications of the widening vistas of our hobby with the increasing technical developments in all fields of electronics.

These changes open so many new expanses that amateur radio can no longer be considered a single hobby. Newcomers are practically forced to specialise in one field or another. No single person can hope to cover all the possible spheres of activity that open up when he or she embraces amateur radio as a pastime.

New technical departures appear practically daily and one must decide quite early upon his future interests, whether the VHF's, the HF's DX operating, etc. Otherwise one may become engulfed in a mass of unfinished equipment and with many ideas but not the time to execute them.

Twenty-five years ago it was possible to build an effective transmitter one weekend, a suitable receiver the next and to be well equipped to proceed on the air.

In the future it appears certain that most amateurs will only be able to review briefly fields outside the particular one selected for the main interest.

NSW Conventions

ATTENDANCE at the two NSW Amateur Radio Conventions conducted over the October Labor Day weekend was a record and some amateurs travelled hundreds of miles to be present.

Griffith was the venue of the South Western Zone's annual event, and over 80 persons were there for the two days of the convention. Expressions of appreciation on the effective organisation reflected credit on the efforts of Stuart Savage, VK2PL and his band of willing helpers. A representative gathering of amateurs from as far afield as Sydney and Melbourne included many NSW WIA councillors.

The convention was officially opened by State President Jim Corbin, VK2YC, and the only complaint recorded was in reference to lack of sleep. Some tallied five hours for the two days.

The results of the various field events conducted were as follows:—

40 metre band scramble:— First, Don Haberecht VK2RS, Albury; Second, Vince Cahill, VK2VC, Sydney; Third, Jim Edge, VK2AJO, Coolamon; Fourth, VK2AGJ, Griffith Radio Club.

144 mc Hidden Transmitter Search:— First, Vince Cahill, VK2VC, Sydney; Second, Ross Weeden, VK2PN, Tumut; Third, Jim Edge VK2AJO, Coolamon; Fourth, Keith Dodd VK2ZAA, Tumut.

144 mc/s Band Blindfold Hunt:— First Gentlemen, Evan Savage, VK2ACS. First Ladies, Mrs. Arntsen, Wagga.

Held at a different location in the zone each year, the convention is becoming increasingly popular. Coolamon QTH of zone officer Jim Edge, VK2AJO, is the selected spot for the 1957 event.

The second gathering was that of the Hunter Branch of the WIA at Blackalls, Lake Macquarie, held over three days. After the official opening by the Branch President Bill Hall VK2XT, the Saturday afternoon session was handed over to the NSW VHF section with President Perc Healy, VK2APQ, as compere. Section members VK2HL, VK2VL, VK2ZAV, VK2ANU, VK2VU and VK3PO described and displayed VHF equipment. A wide range of subjects were covered.

During the evening John Moyle, VK2JU, presented a selection of color slides and spoke of his recent overseas trip with due reference to TV

The field events were conducted on the Sunday including a scramble and 144 mc/s searches.

The hidden transmitter search contest was won by Harold Whyte, VK2AHA, second Bill Hall, VK2XT, third Phil Norman, VK2ZCF.

Old timer VK2XO, Crieff Retallick, won the blindfold 144 mc hunt with Perc Healy, VK2APQ, in second place. During the Sunday evening 144 mc activity was at a peak with mobiles at Blackalls working to Newcastle and to the Northern section of Sydney

Blackalls weekends are an integral part of Hunter Branch activity and the location is ideal for amateur conventions.

ARRL DX contest

RESULTS of the Telephony section of the ARRL 1956 DX contest, saw some good scores recorded — the highest ever. Best scores were ZS2DW with over 1000 contacts and 225,000 points. In Asia JA3DB was the leader, and in Europe EA4DL, EI5I, G2PU and DL4AJ scored well. In South America HC1ES was in front with 391,000. An interesting point he made 294 contacts on the 27 mc/s band. All out winner in the US was Bill Leonard, W2SKE/2. with a score of 632.000 points.

In the CW section, 15 W stations topped the previous highest score and no less than 10 operators passed the half million points mark.

Both US winners Telephony and CW operated away from their home QTH, possibly for a quieter QTH and an available antenna farm.

Another point of interest was the fact although only 5 official logs were received from G operators participating in the Telephony

section. W2SKE/2 contacted no less than 120 different G's during the contest period. It must be disappointing at times to organisers of contests, to receive so few logs in return. Published results apparently have little bearing on the actual popularity of any contest.

RSGB contest

THE DX operators are reminded of the RSGB's 21 and 28 mc/s band contest to be conducted on November 24 and 25 (full rules appeared in the September issue).

Telephony only is to be used, and serial numbers to be exchanged are as usual, RS report and three figures indicating the number of the contest. Stations in all parts of the world will contact amateurs in the UK covering prefixes G, GC, GD, GI, GM and GW.

DX conditions change

THE amateur radio year has really just commenced with the arrival of the spring equinox and the resultant switch in DX conditions.

October should be an outstanding DX month and with two DX contests, the VK-ZL and CQ tests, some excellent contacts should be made. It is anticipated that the sunspot number for October will be the highest ever recorded during any DX contest. No radio storms are expected for the month so a review of the DX logs for the period should make interesting reading.

The 21mc/c band in the first week in October provided the best signals yet heard. Some fine contacts were logged by stations participating in the Telephony Section of the VK-ZL DX contest. Signals from Europe were at tremendous strength over a period of hours, both morning and evening openings appearing.

Signals from Africa during the afternoon provided the following prefixes on CW—ZD2, CR6, ZS1 and ZS7 all could be readily contacted with resorting to beam antennas.

From Eastern Australia West African stations are amongst the most difficult to contact.

If 21mc/s continues to provide these Africans DX operators here will be able to add some of the rarer prefixes to their countries' total.

Two thoughts arose from observations during the contests, the first the necessity of populating the 14300 to 14350 kc/s section of 12 mc/s, and secondly the need for stations to spread out on 21 mc/s.

QRM on the 14100-14200 kc/s sector of that band was extremely heavy, while only a few stations were heard on the high frequency end. The use of the latter segment would make contacts easier to record.

The crowding of the middle of the 21 mc/s band is also pronounced, both W and foreign amateurs crowding the edge of the W telephony allocation.

The increasing number of stations heard with improved conditions necessitates changes of operating technique and the announcement during CQ's of the tuning procedure and beam heading was being used to advantage.

WIA convention

THE recent suggestion made in the Federal Parliament that the Government should sponsor amateur representatives to the next International Conference at Geneva in 1959, draws attention for the need to revive amateur interest in Federal affairs, an interest which has not been evident of recent years.

Divisions have been too much occupied with domestic matters and not enough concerned with the major problems facing all who are wondering what the future of our hobby will be.

It is inconceivable that we should believe there isn't enough to talk about at a Convention to justify its being held.

Its true that many Institute matters can be disposed of by correspondence, but nothing can take the place of a personal exchange of ideas and airing of possible grievances like a Convention.

These should be held annually from now on, and an effort made to secure the services of the most competent and experienced amateurs to serve on the Federal Council. Otherwise we are placing the Federal Executive in the impossible position of having to run the Institute on its own, a task it was never intended to undertake.

QSL bureaux

ARRL QSL Bureaux covering the United States, its possessions, and Canada, are listed below, several changes have been made in recent months. QSL cards of the listed call areas should be directed as shown:—

W1, K1 — D. W. Waterman, W1IPQ, 99 Flat Rock Rd., Easton, Conn.; W2, K2 — E. F. Huberman, W2JIL, Box 746, GPO, Brooklyn 1 New York; W3, K3 — —Jesse Bieberman, W3KT, P. Box 400, Bala-Cynwyd, Penna.; W4, K4 — Thomas M. Moss, W4HYW, Box 644, Municipal Airport Branch, Atlanta, Ga.; W5, K5 — Robert Stark, W5OLG, PO Box 261, Grapevine, Texas; W6, K6 — Horace R. Greer, W6TI, 414 Fairmount St., Oakland, Calif.; W7, K7 — Joseph P. Vogt, W7AS, 3599 Karen Av., Salem, Oregon; W8, K8 — Walter E. Musgrave, W8NGW, 1294 E. 18th St., Cleveland 10, Ohio; W9, K9 — John Schneider, W9CFT, 311 W. Ross Av., Wausau, Wisc.; W0, K0 — Alva A. Smith, W0DM, 238 East Main St., Caledonia, Minn.; VE1 — J. J. Fader, VE1FQ, 125 Henry St., Halifax, N.S.; VE2 — Harry J. Mabson, VE2AP, 122 Regent Av., Beaconsfield West, Que.; VE3 — Leslie A. Wetham, VE3VR, 32 Sylvia Crescent Hamilton, Ont.; VE4 — Len Cuff, VE4LC, 286 Rutland St., St. James, Man.; VE5 — Fred Ward, VE5OP, 899 Connaugh Av., Moose Jaw, Sask.; VE6 — W. R. Savage, VE6EP, 883 10th St. N., North Lethbridge, Alta.; VE7 — H. R. Hough, VE7HR, 2316 Trent St., Victoria, B.C.; VE8 — W. L. Geary, VE8AW, Box 534, Whitehorse, YT.

VO — Ernest Ash, VO1A, PO Box 8, St. John's, Newfoundland; KP4 — E. W. Mayer, KP4KD, 1061 San Juan, P.R.; KH6 — Arthur H. Fuchikami, KH6BA, 2543 Namauu Drive, Honolulu, T.H.; KL7 — Box 73, Douglas, Alaska; KZ5 — Catherine Howe, KZ5KA, Box 407, Balboa, C.Z.

Interference to broadcast

OFFICIAL IA Broadcasts conducted Sunday mornings are still suffering considerable interference, generally from interstate stations. Often serious QRM is experienced especially to amateurs located in country areas close to the State from which the offending signal is emanating.

Official broadcasts are generally transmitted on 7146 kc/s and stations using 7 mc/s on Sunday morning should listen out for WIA news sessions and keep the channels clear.

New South Wales: Secretary, H. King, VK2AUS, 19 St. Pauls Rd., Balgowlah.

Victoria: Secretary, F. G. Bail VK3YS. Correspondence to The Administrative Secretary, Mrs. May, COR House, 191 Queen St., Melbourne.

Queensland: Secretary, W. J. Rafter, VK4PR, Box 638J, GPO, Brisbane.

South Australia: Secretary, B. W. Austin, VK5CA, Box 1234K, GPO, Adelaide.

Western Australia: Secretary, J. Mead, VK6LC, Box N1002, GPO, Perth.

Tasmania: Secretary, M. Hurburgh, VK7MH, Box 371B, GPO, Hobart.

Papua — New Guinea: Secretary, D. Lloyd, VK9OQ, c/o OTC, PO Box 56, Port Moresby.

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re's Your Answer Tom!

(Continued from Page 95)

imer with one winding only. The nsformation of voltage occurs be-en one pair of tappings and another r on the same winding.

Provided all the turns on the winding so coupled that there is no leakage s, passing an alternating current ough part of the winding will induce tages in the whole of the winding.

The turns ratio which decides the tages available at the various taps, is ratio of the turns included in one cuit to those included in the other cuit.

An auto-transformer does not find le application in normal radio cir-try, due to the fact that it is not ssible to isolate circuits in respect DC connection, while maintaining the coupling.

★ ★ ★

What is Lenz's Law?

Lenz's Law states that the voltages duced in a conductor, through anges in the linkage between the nductor and a magnetic field, are a direction which tend to oppose change of linkage.

In a transformer, for example, on application of an alternating vol-e, current flows in one direction set-g up a magnetic field. As the lines force build up, they induce a cur-nt in the winding, in the opposite rection, which tends to cancel the ginal current. In fact, the only rrent that flows through the winding the difference between the two cur-nts.

As the alternating cycle reverses, actly the same procedure applies in verse.

★ ★ ★

What is a dynamometer?

A dynamometer, Tom, is an instru-nt for the measurement of power. operates on the principle that, if a rrent is passed in the same direction rough two adjacent coils or wires, e of which is fixed while the other free to move, attraction will occur tween the two coils, causing the free mber to rotate.

The extent of rotation is propor-nal to the amount of attraction be-een them and hence to the amount current that flows through them. pointer attached to the movable mber is made to move across a librated scale, allowing readings to made.

★ ★ ★

What is Current Density?

Current density, Tom, is the mea-re of current intensity in relation the cross-sectional area of a con-ctor in which the current is flowing. It is usually expressed in amps per uare inch. As an example, if a rrent of 5 amps is flowing in a wire ving a cross-sectional area of one nth of a square inch, then this is uivalent to a current density of 50 ps per square inch.

Current density is an important ctor in deciding the diameter of a nductor for current carrying pur-ses. If the current density is too gh, the conductor will overheat.

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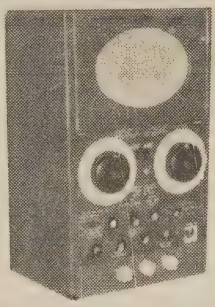

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24V	550V 375MA	2	0	0
24V	250V 60MA	1	5	0
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12V	1200V 200MA	6	10	0
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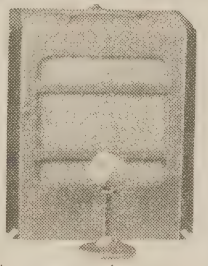

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6 valve	40 watt	£32/ 7/6

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MULLARD 5/10.

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Parts wired and tested Strips, turrets etc. all complying with P.M.G. specifications. Expert assistance to build.

NCIENT ART
: MAP MAKING

(Continued from Page 19)

globe is enclosed within a paper
der as in Fig. 5. Where the paper
ies equator all round, you can mark
ne meridians as in the conic pro-
n and they will be equally spaced
now you imagine a line drawn
the centre of the globe right
gh the point where the parallel is
n on the globe, and continue this
until it cuts the wall of the paper
der, you will have points on the
der from which to draw the paral-
when the cylinder is opened out.
e cylinder is now opened out flat.
neridians are drawn vertically, and
parallels horizontally.
te that, while the meridians are
y spaced, the parallels are not. In
the distance between the 60th and
parallels are enormously exagge-
.
at is one reason for this propection.
ie parallels were merely extended
parallel from the globe to the cylin-
is in the cone, the East West would
grossly exaggerated as compared
the North South distances. When
n in to the network, all the land
ces between the 60th and 75th
lels would be long and squat —
of all proportion to the true shape
ie act of extending the parallels
the centre of the globe gives a
sponding distortion north and south,
so corrects this objection. Fig. 6
s what the map looks like after
projected according to the Merca-
ystem.
ie Mercator projection has several
anding characteristics. For any
l area the shape of the land or sea
ces is the same as on the globe.
ever for large areas the shape is
ly distorted.
important characteristic of the
ator projection is that it is the only
m which shows all compass direc-
as straight lines, instead of curved
as on other maps. This is of great
ntage to a navigator, for all he has
o is to connect his point of depar-
on a Mercator chart by a straight
to his destination. He then reads
compass direction of this line by
is of figures on the chart and sets
vessel on its correct course.

HER TYPES

actically all charts used for naviga-
are Mercator propections. There
many other types of projections such
ie Azimuthal projection, Sinusoidal
ection, Eckert projection and so on.
ll have their uses, some for one
ose and some for others. No single
ection is useful for all purposes
ll geographers have to know the
ciples of various projections so that
can make an intelligent choice for
fic uses.
hen simple diagrammatic maps are
ired such as those used by estate
ts, to give an idea of how a par-
ar estate looks (really better than it
ally is) simple horizontal parallels
the best, as the lettering thereon
be straight and clean.
aps are made to a scale of some
ion of the true size of the area de-
picted. Some curious features become apparent when considering the scale of a map.

It is obvious that, in order to draw a map of a fairly large area of say ten miles square on a small piece of paper, a small scale must be used. It may be a scale of one inch to the mile.

IMPORTANCE OF SCALE

Now an inch is one-63,360th of a mile, so that the scale is really one-63,360th of the true size.

Say we wish to draw a road on our map, and the road is 30 feet wide. If the map is true to scale in all detail at one inch to the mile or 5280th size, then the 30 foot road would have to be drawn 30/5280 inches or 176th of an inch wide. This is finer than can be drawn without microscopic aid.

It is therefore obvious that all detail of a local map cannot be drawn to scale, and roads and the like are always greatly exaggerated in width to make the map any use at all.

Motorists can easily be misled by such matters, especially as to the appearance of curves on a map. What may look like an easy gradual curve on a map may, in reality, be a very sharp one, because the acuteness of the curve is hidden by the smoothing out effect of the double lines.

The same applies to bends in rivers as shown in the usual map.

Announcement . . .

Electronic ORGANS

Many months ago we made preliminary announcements of a "Build-it-Yourself" electronic organ kit.

Since then we have had hundreds of enquiries concerning this project, and we are making this announcement to assure our clients that this production is still well in hand.

The reason for delaying so long? . . . One is that we could not get a sufficiently large dollar quota to pay the patentees the royalties due to them: the other is that we will not make the kit available until such time as there is a ready and assured supply of all components — Australian-made components.

We have produced a splendid prototype organ, wholly Australian, and which is now a subject of a patent pending, and which will be released as soon as possible. This has necessitated the rewriting of the technical paper "Build Yourself an Organ" which will, in due course, be available throughout the world — whether or not you buy the kit.

All those folk who have taken the trouble to contact us in this matter may be assured that we have recorded their names and that they will receive direct word of this project when the kit is ready for presentation.

We have a small stock of
"THE ORGAN BUILDERS' MANUAL"
available at 13/6, post free. This book is the catalogue of one of our associate companies — Electronic Organ Arts Inc., of Los Angeles, USA — and is copiously illustrated throughout its 120 pages.

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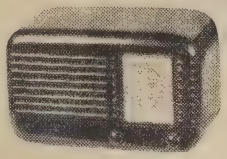

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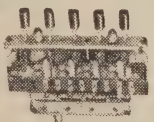

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'ROM THE SERVICEMAN WHO TELLS

(Continued from Page 47)

eatment, the only course is to remove e sockets. Two types appear to be common use, one which mounts on e component side of the board (away om the wiring) and one which mounts the wiring side. The latter is dealt ith first.

OCKET REPLACEMENT

"REPLACING SOCKETS ON WIR-NG SIDE. The following instructions e for complete valve socket replace-ent. Separate instructions are given r replacing sockets mounted on the mponent side of the board. Be sure replace valve sockets with exact type originally used.

"Removal of valve sockets from the iring side of the board should be per-rmed as follows:

(1) Apply the soldering iron and ushing technique to each lug as given earlier instructions for removing mponents.

(2) It may be difficult to break the tire connection by brushing. There-re, after brushing, apply the solder-g iron a second time to each lug. In-rt a knife blade between the wiring il and the socket lug. Bend the lug ward from the foil. DO NOT PER-ORM THIS OPERATION ON THE ARTHING LUG.

(3) After all lugs have been cleaned om the wiring foil apply the soldering on to the earthing lug on the com-onent side. Grasp the socket and owly pull it away from the board. The cket will free itself when the earth-g lug solder has become molten. Re-ove any thin film of solder that may rm between the earth foil connection d any of the socket foil connections.

"CAUTION: Earth terminal connec-ons to the valve socket are made un-rneath the sockets with copper wiring il. When removing the socket be rtain that none of the foil has peeled f between the socket lugs and the ntre earth connection.

ARTH CONNECTION

"The portion of the foil most likely peel and break when removing the cket is the section which is soldered the earthing lug of the valve socket. this is overlooked when replacing e socket a mechanical connection ay still exist between electrical earth d the socket terminal, but an inter-ittent connection is very likely to de-lop later which may be very difficult locate.

"Therefore, be certain to replace any issing foil with hookup wire. This re may be routed underneath the cket or a jumper may be connected top of the board to the necessary lve socket terminals."

Finally, there is the socket mounted the component side of the board his procedure is very similar to that ibed for IF transforme c., and is as follows:

"(1) Apply the soldering iron and ushing technique to each socket lug given in earlier instructions.

"(2) Apply the soldering iron to each lug (including the earthing lug) and bend the socket lugs upward from the foil with the blade of a knife.

"(3) Rebrush the connections, after re-heating the joints.

"(4) Cut the lugs off the sockets as close as possible to the board. Rebrush the connections if necessary.

"(4) Apply the soldering iron to the earth lug and lift the socket from the board.

"CAUTION: When installing the new socket, it may be difficult to insert the socket lugs through the holes in the board due to the very close tolerance. If too much pressure is applied in attempting to force the socket terminal through the holes, the board may break. Therefore, enlarge the holes slightly so that they can be inserted without excessive pressure. A small reamer or penknife may be used for this purpose.

"(7) Insert new socket, bend over its lugs, and solder the connections."

Well, there it is. I don't suggest that either you or I now know all there is to know about printed circuits and the servicing thereof; but at least we should have a few ideas straightened out.

As I said at the beginning, one of the most important is the simple fact that printed circuits CAN be repaired. Armed with this knowledge and some of the hints in the above pamphlet, I feel a good deal more confident about tackling one of the things when it comes along.

FILTER CHOKE FOR THE LITTLE GENERAL

(Continued from Page 55.

coil. The only component likely to need moving is the .1 mfd screen by-pass, and which may need to go a little nearer the end of the chassis. The choke should have its terminals towards the speaker transformer.

We suggest the .1 mfd be wired directly to the appropriate coil pin rather than the tag strip terminal as previously It can still use the same earth connection.

The manner of wiring the choke was chosen to avoid altering any of the critical voltages in the front end of the set, and retains the 3500 ohm resistor. This arrangement is shown in the section of the circuit reproduced.

Remove the resistor temporarily, and terminate the 1st electrolytic, a lead from the choke, the lead to the speaker transformer, and the screen of the 6BV7 on what was previously a vacant terminal on the 4-terminal tag strip.

Now terminate the HT line running to the 2nd IF transformer on the vacant terminal of the adjacent 8-terminal strip and connect the 3500 ohm resistor between these two terminals.

Finally, the other lead from the choke is taken to the positive of the first electrolytic. Compare these instructions with the modified circuit shown and all should be plain sailing.

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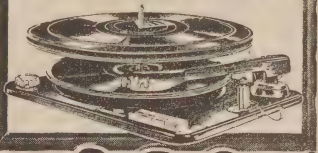

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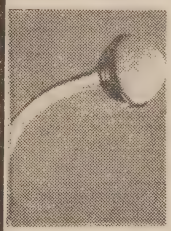

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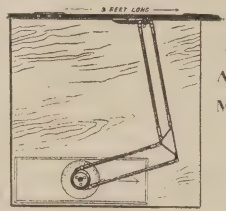

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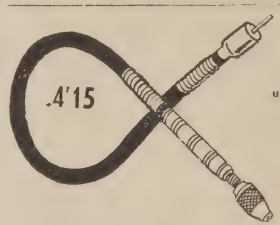

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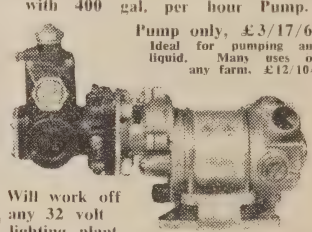

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Eng. 0-500 Micro amps 3½in DC	50/-
Eng. 0-6 Amps 3¾in DC	25/-
Eng. 0-25 Volts 2¼in DC	22/6
Eng. Ohmmeter reads 0-60 M.Amps 0-500 ohms, 0-15 volts, 0-3 volts 3in dial, 0-100 milliamps, new	45/- 17/6
4 x 4½ 0/1 Milliamp Meter	£5/5/-

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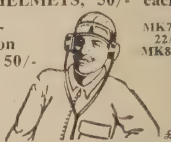

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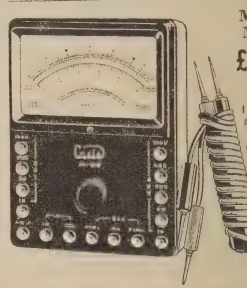

160 Microamps sensitivity. DB Scale —20 plus 36

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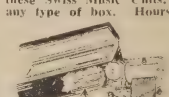

30/- EACH

Lili Marlene, Blue Danube, Harry Lime Theme Wedding March, Merry Widow, Happy Birthday, Anniversary Waltz, Silent Night, Swedish Rhapsody, Annie Laurie, How Dry We Are, Roll Out The Barrel, Teddy Bears' Picnic.

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ANSWERS TO CORRESPONDENTS

B. (Bendigo, Vic.), writes to say that his ...ience has been that regenerative receivers ...a Reinartz coil tend to favor the stations ...high frequency end of the band. He ...lers if this is the rule or the exception ...if we could offer an explanation.

Relative performance at the ends of the ...depends on the design of the components ...the circuit. The detector of your circuit ...oscillate more easily at the high frequency ...of the band because the reactance of the ...citor at a particular setting decreases as ...frequency increases and therefore less capaci... may be needed to make the detector ...illate. The issue is confused because of ...presence of the inductance of the reaction ...ing. The amount of energy transferred ...een the primary and tuned windings ...nds on the coupling factor which, in turn, ...nds on the setting of the tuning capacitor. ...her factor is the inductance of the primary ...h if small would cause the signal to be ...ucted to earth more easily at the low ...ency end of the band. There is no ...reason why regenerative receivers favor ...high frequency end of the band but it ...ll easily be that they do so with coils ...able. Most of the gain of a superhet ...ver is contributed by the intermediate ...iency amplifier and audio stages which are ...tuned and therefore the performance is ...clearly constant over the entire band. ...aerial coil normally has a high-impedance ...ary winding intended to sustain sensitivity ...he lower signal frequencies.

D.W. (Beaconsfield, Tasmania), sends a ... of a troublesome car radio as being of ...ible interest to the Serviceman.

Many thanks for your story, A.D.W., ...we will pass it on to the Serviceman. It ...uite surprising the number of faults which ...can locate in some sets, even when the ...s still functioning after some kind of fashion. ...s also surprising what the owners will ...ate in terms of performance. We trust ...new speaker will solve the remaining prob...

K.L.G. (Blackwood, S.A.), writes to con...ulate the Serviceman on his recent com...ts regarding electrical safety and to sub... a case which he recently encountered and ...h he considers may be of interest to other ...ers.

We are glad to learn that you find ...e articles interesting, K.L.G., and many ...nks for the story you submit. We will pass ...n to the Serviceman for his possible use ...a later date. In the meantime we can ... comment that earthing like many other ...gs in radio and electronics, should never be ...n for granted.

D.R. (Ballarat, Vic.), is interested in the New Baby Mantel set described in the February, 1956, issue. Since he has only DC power available he wants to know if it could be modified for DC.

A. Sorry, D.R., but we make it a policy not to encourage readers in the construction of appliances of this kind, particularly readers like yourself who may have only a limited knowledge of radio and electricity. Our reason, we feel, is a sound one, since such devices can be extremely dangerous if incorrectly built and/or used. The position is made worse by the fact that such danger is not always immediately apparent and a supposedly harmless device can easily become a lethal one if used under slightly different conditions. So take our advice, D.R., and stay away from home-made AC/DC or DC radio appliances. You will probably live longer.

E.R.M. (Strathmore, Vic.), has recently completed building the Rambler portable and complains of weak reception on the low frequency end of the band. He also mentions that the receiver is inclined to "whistle" between stations.

A. It does seem that the whistle you refer to, E.R.M., is in effect oscillation, which could prevent you from correctly aligning the set and could be related to the lack of sensitivity on some of the stations. We would advise you to check the wiring and layout. You may perhaps have a faulty component, in which case you may require the aid of a radio serviceman. For information on home-made loop aerials, we refer you to a further article on the Jubilee Portable in the December, 1953, issue of R, TV and H.

R.D. (Cootamundra, NSW), writes to congratulate us on the article on wideband oscilloscope amplifiers and ask two questions regarding audio amplifier characteristics.

A. Your kind remarks are noted and appreciated. We will be publishing more information on television test equipment in the next few months and no doubt there will be much to interest you. Your method of calculating amplifier feedback is correct. In general, the number of decibels is calculated by multiplying the common logarithm of the voltage ratio by 20. In your case, the voltage ratio is 4, the log. of 4 is near enough to 0.6 and therefore the feedback is 12 db. Operating conditions published by valve manufacturers are typical only. Their main purpose is to save time when designing ordinary circuits. However, there is nothing to stop a designer choosing some other operating conditions should it suit his purpose and not transgress maximum ratings for the particular valve.

S.M.L. (Wingham, NSW), writes to tell us of his experiments with a transistor audio amplifier using an OC71. In wiring the amplifier originally he made a mistake and interchanged two resistors. He has since discovered the mistake but finds that the amplifier works best with the incorrect wiring.

A. The resistors you interchanged govern the base forward current bias on the transistor and the mistake you made would greatly increase the standing collector current. This would, as you say, allow greater power output but increase the collector dissipation beyond that intended by the circuit designed. If the extra power output is essential we suggest that you use larger transistors. A suitable circuit for a pair of OC72's, in push-pull appears in the August, 1955, issue of R, TV and H.

P.W.S. (Young, NSW), asks us for details of a CRO to operate from a 6 or 12-volt battery. He wishes to use the instrument for adjusting motor ignition systems.

A. This one is a little outside our normal scope, P.W.S. A cathode ray tube could be set up to operate from a vibratory supply using ordinary radio technique but we cannot offer any worthwhile comments on the type of sweep circuit that would be suitable or even the worth of the instrument, assuming that the waveform and timing of the spark plug pulses were able to be displayed.

J.M.H. (Charlestone, NSW), writes an 8-page letter telling of his experiments with a modified R, TV and H receiver, a measuring bridge and oscillator and in addition asks some questions on television and recording.

A. Sorry, J.M.H., but we must adhere to the editor's edict regarding queries as set out on this page. The best we can do is file the letter with the "Answer Tom" correspondence and hope to deal with your questions one by one over a period of time. We do not like the idea of connecting the high tension system of a receiver directly to the power mains without a transformer because of the danger of shock. This applies particularly in the case of an experimental set.

W.P. (Chatswood, NSW) writes to express his regret at the fact that we continue to describe a particular method of cutting large holes in chassis, which he describes as a hazard to readers' frayed tempers, fingers, and the chassis. He draws our attention to a tool called a tension file which can be used in a hack saw frame to cut holes of any shape or size.

A. Many thanks for your comments and suggestions, W.P., we are always glad to hear from readers and learn what they think of our suggestions. While we agree that the method you suggest is quite a good one, we cannot quite agree that the "classic" method is really as bad as you say. Various members of our staff must have cut literally hundreds of holes by this method before the days of socket punches, yet ill regard it as a simple effective method, capable of producing neat results if one is prepared to exercise reasonable care. We have not tried the method you describe, although we have in our workshop devices similar to the file mentioned, which are known as spiral saws and can be used with a coping saw frame. Designed primarily for wood, they are also capable of cutting aluminium. However, we feel that the "roundness" of the hole cut in this way would depend on the skill of the worker and would probably still need to be finished off with a half-round file in many cases. Short of a socket punch, we would still plug for a doctored carpenter's centre bit as the best approach. Used with reasonable care, it is capable of producing a very clean cut.

A.E.M. (Mount Garnet, Q) sends us a subscription for Radio, Television and Hobbies and takes the opportunity to express his appreciation of the magazine and to offer a few comments and suggestions.

A. Many thanks for your subscription, A.E.M., and this has been forwarded to the appropriate department. We are also glad to hear your comments and suggestions, particularly those regarding amateur articles, which we will keep in mind. Unfortunately, this type of article does not lend itself so readily to regular presentation and, much as we appreciate your points, we cannot see our way clear to institute such a series at the moment. The tabulation and comment on the various amplifiers also presents a problem. The main characteristics of each amplifier were listed in each article and are probably the best comment we can give for each. Without repeating most of this matter, it would be impossible to describe any one amplifier as "best" for any set-up. We feel that this is a problem which only the individual can solve since only he knows how much he has to spend, what space is available, and what standard of performance he requires.

The Radio, Television and Hobbies Query Service

All queries concerning our designs, to which a POSTAL REPLY is required must be accompanied by a postal note or stamps to the value of TWO SHILLINGS.

For the same fee, we will give advice by mail on radio matters, provided the information can be drawn from general knowledge. UNDER NO CIRCUMSTANCES, however, can we undertake to answer problems involving special research, modification to commercial equipment or the preparation of special circuits.

Whatever the subject matter, we must work on the principle that a letter is too involved if the reply takes more than 10 minutes of our time.

Queries not accompanied by the necessary fee will be answered FREE in the columns of the magazine and presented in such a way as to be of interest to other readers.

To those requiring only circuit reprints, &c., we will supply for TWO SHILLINGS diagrams and parts lists from our files covering up to three constructional projects. Scale blueprints showing the position of all holes and cut-outs in standard chassis can be supplied for 5/-. These are available for nearly all our designs but please note they do NOT show wiring details.

Address your letters to The Technical Editor, RADIO, TELEVISION and HOBBIES, Box 2728C, GPO, Sydney.

Note that we do not deal in radio components. Price quotations and details of merchandise must be obtained direct from our advertisers.

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7C7	5/-	6AC7	3/11
6F6	12/6	7193	2/11
6SH7	7/6	1629	7/6
6C8	12/6	1632	10/6
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12SR7	12/6	954	5/6
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6AJ5	12/6	801	25/-
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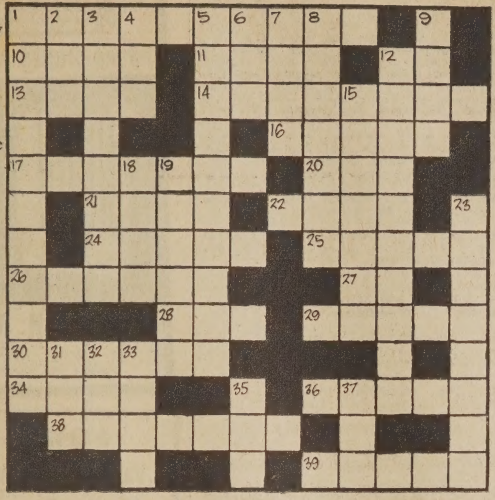


ACROSS

1. Beyond TV "line of sight". (2 words.)
10. Italian Currency.
11. King of the beasts.
12. Towards.
13. On.
14. Rubbers.
16. On a wall.
17. Expresses power-level difference.
20. Flow.
21. A Norse God.
22. Limbs.
24. Reposes.
25. Set of furniture.
26. Period of rest.
27. Since.
28. Railway Refreshment Rooms (abbrev.).
29. Geological beds of glauconitic sands in the weald of Kent and Sussex.
30. Boyish girl.
34. Twelve months.
36. Delicate white clouds.
38. An atomic furnace.
39. Anode.

DOWN

1. Quantity of flux passing through unit area.
2. Tear.
3. Part of a transformer (2 words).
4. Nancy (abbrev.).
5. Rudimentary.
6. Atmosphere.
7. Wander.
8. Makes safe.
9. Boy's name.
12. Semi-conductive device.
15. South American country.
18. Period in March.
19. French wine saloon.
23. To effect visual transmission.
31. Poetical abbreviation of over.
32. Girl's name.
33. Scottish hillside.
35. Humble.
37. Sick.

Solution and further crossword next month

P	L	A	T	E	C	I	R	C	U	I	T	
E		U		G		N		R		N		A
R	A	T	I	O		C	H	A	S	S	I	S
M		O			E		B		U		T	
E	N	D	O	D	Y	N	E		L		A	
A		Y			T		B	L	A	S	T	I
N	O	N	E	N	T	I	T	Y		T		I
C		E		I		V			O		C	
E			S	P	R	E	A	D	E	R		
		E		P			G	O			F	F
B	A	T	T	E	R	I	E	S		S	O	U
T		U		R			N	E	P	E	R	S
U	N	I	T	S		L	T	D		T	E	E

Last month's solution

J.R.F (Yass, NSW) describes how he modified a simple one valve set and obtained a vast improvement in results.

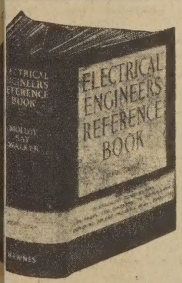
A. Unfortunately, J.R.F., you have not given us complete details of the manner in which the aerial was coupled to the set originally, and this is a most important consideration. We imagine, from what you say, that it was coupled to the grid winding via a coupling capacitor, rather than to a primary winding. Unless the coupling capacitor was small enough this could have two bad effects. It could so load the detector that it would no longer oscillate, thus rendering the regeneration control ineffective and prejudicing the selectivity. (You do not mention whether the set performed correctly in this regard.) Secondly, by simply delivering too much signal to the detector it makes separation difficult, particularly in the vicinity of a local station. Coupling the aerial in as you have done could reduce the coupling and thus clear the way for other stations to be heard. However, it is far from an ideal arrangement and we strongly recommend a more conventional approach, namely, the use of a correct primary winding and an optimum size aedial. A lot can be done by pruning the length of an aerial, the lower pickup after producing a vast improvement in selectivity. The use of the power supply earth could improve signal strength if it is a long earth, though it can also increase sensitivity to electrical noise, &c.

PARTS FOR NOTHING!

Two NSW readers have written to say that they have a quantity of radio parts which they would like to give away to yuong enthusiasts. Their names and addresses are:

Mr. R. Barry, 42 Barry Street, Neutral Bay, Sydney. (Please call any time after 7 pm.

Mr. P. Butler, 1 Darley Road, Randwick. (Please call on Saturdays only.)



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FOR SALE: Palec valve tester and circuit tester brand new few months, must sell £45. Two reels of double sided recording tapes also brand new, £6 or offer. 1 pair 40 mm lens for 9.5 mm projector. £5. **T. Loricco, 50 Murray St., Colac, Vic.**

FOR SALE: Receivers AR8, AR12, complete also 1155 less valves write. **G Esman, 70 Queen St., Colac, Vic.**

FOR SALE: Eddystone 840 communications receiver. **A/C Hall, D.J., Course, 3163. A.T.S., R.S.T.T., R.A.A.F., Wagga, N.S.W.**

FOR SALE: Model Engineers. For supply of Castings and Designs see 5/- Catalogue. **Bolton, 70 King St., Sydney.**

FOR SALE: Communications Receiver AMR100 complete with modified BC453 Q5'er good condition £35. **M. H. Myers, 109 Springdale Rd., Killara, N.S.W. JX2965.**

FOR SALE: Mullard horn with Jensen bass spkr., £18/10/-. Collaro transc. turntable with MBH, 12in arm, LP head, £28, new. Baker 12in 20 watt bass speaker, chamois suspens., £16. Will demo. evenings only. **W. Yashin, 35 Hamers Rd., Northmead.**

FOR SALE: Collaro RC54 record changer, new, £17. **35 Lewis St., Balgowlah, XJ4193.**

FOR SALE: Back Nos. of Radio and Hobbies, except March, 1953, at 2/6 per copy posted, also Radio Maintenance, New Zealand Radio Electronics, 1946 English Wireless Worlds and Practical Wireless at 1/6 per copy. **A. J. Cox, 13 Glover St., Belmont, N.S.W.**

SALE: All back issues R & H, Jan., 1943, to Sept., 1950, 2/- per copy posted, 15/- per year delivered in Sydney or 20/- per year posted. All other copies 4/- each or quote for quantity. **T. Weir, 73 Gibson Av., Padstow, UY8056.**

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SELL: R & H Standard Tuner RF Stage factory built as new £11. **Mr. K. Stewart, 63 Lewin St., Bardon, Brisbane.**

SELL: Leak Vari-Slope Pre-Amp £12. Bakers 12in C/S Speaker £12. **McNaughton, 30 Cole St., Hawthorn, Vic.**

SELL: Valve and circuit tester, excellent order. Tests latest valves £17. **P.O. Box 72. Maryborough, Qld.**

SELL: Hallicrafter S.39 portable AC/DC RX or exchange RX BC312 series. Replies **J. Read, Box 12, Goombungee, Qld.**

SELL: University T.S.T. valve and circuit tester, good order £45. **L. Meadows, c/o Regent Theatre, Hamilton, Vic.**

SELL: Two American "Presto IC", high fidelity disc-recording cutterheads, perfect condition £29 ea.
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SELL: SCR 522 Tx Rx less valves, etc., £4 ea. AT 300 Tx £1 ea. Generators 24v 10/- ea. 100 dipole elements £4. 12½ and 1M SW pots £2. New M.C. meters £1 ea. 2 new steel card cabs £2 ea. Loop aerials £1 ea. Callers only, **P. W. Butler, 1 Darley St., Randwick.**

SELL: Printers type, new, £20. Exchange, amplifier, charger, w/talkies or ? **Hester, Box 387 Leeton, N.S.W.**

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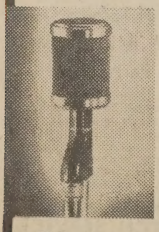

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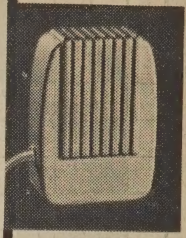

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